Assessing the Environment Domain of the Canadian Index of Wellbeing: Potentials for Leveraging Policy

by

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Author Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revision, as accepted by my examiners.

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Abstract

This thesis is aimed at understanding the environment domain of the Canadian Index of Wellbeing (CIW) and how it can further contribute to communicative strategies that promote strategic sustainable development. Several ways of conceptualizing, describing and measuring the relationship between human wellbeing and the environment have been attempted in the past through a number of wellbeing indices, but none of these have been entirely successful at capturing the intricacies and potential implications inherent in the relationship. This study attempts to cast light on how the environment domain of the CIW can benefit from having a guiding framework to better communicate the pressures placed on the environment and show links to other aspects of societal behaviour and wellbeing. The goal is to contribute to a better conceptualization of sustainable progress and a tool for policy integration.

An in-depth literature review was conducted to report on how human wellbeing and the environment have been measured. The empirical basis of the thesis is expert interviews. Six of the interviewees have been involved in the development and application of well-known wellbeing indices. The study also interviewed two regional level planners in Waterloo with deep interest in environmental sustainability. This thesis proposes the Drivers-Pressures-State-Impact-Response (DPSIR) as a guiding framework for the environment domain of the Canadian Index of Wellbeing (CIW) with resource use indicators from Material Flow Analysis (MFA).

Food and Transportation are then proposed to improve the scope of the domain and the index. From a planning perspective, they represent key political, economic and environmental issues. They are both important to Canadian livelihoods and present direct connections between wellbeing and the environment. By presenting food and transportation indicators using the DPSIR framework and MFA as a tool they become understandable and communicate a strong message about how these systems are affecting the Canadian environment.

Other potentially emergent concepts were also presented in this thesis. Further research into many of these concepts, both developing and established, are suggested to further the applicability of the CIW for Canadian policy leverage. This study has the potential to build a universal understanding of what these terms mean and how wellbeing indices can be used to develop a better understanding of the important link between elements of the environment and human wellbeing.

Keywords

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List of Abbreviations

ANDI – Australian National Development Index

CIW – Canadian Index of Wellbeing

DPSIR – Drivers Pressures State Impact Response

DMC – Domestic Material Consumption

DMI – Domestic Material Input

DMO – Domestic Material Output

EU – European Union

GDP – Gross Domestic Product

GNH – Gross National Happiness

GPI – Genuine Progress Indicator

HDI – Human Development Index

MFA – Material Flow Analysis

OECD – Organization for Economic Co-operation and Development

UN – United Nations

Chapter 1 Introduction

1.1 Wellbeing Indices and the Environment

Despite the complexity of the topic, human wellbeing has become a productive and dynamic area of academic research and political interest. This interest has resulted in the creation of new methods that seek to understand, measure and improve how people live their lives. From the perspective of not only policy makers and academics, but as well the general public, there appears to be a significant link between human wellbeing and the natural environment that needs to be explored and maintained. Environmental sustainability is perceived to be crucial for the maintenance of this link. Instead of viewing human wellbeing and the natural environment as being separate entities, they can be more productively viewed as being critical aspects of a very complicated social system. Within this system, all aspects of wellbeing are not only interconnected but also continuously evolving with inputs originating in other systems and outputs being released back into those systems.

Traditionally, human wellbeing and social development has been measured by economic performance. Gross Domestic Product (GDP) is the most well known measure of economic performance in the world; however, measures all economic activity as growth, including national disasters and environmental depletion, whether or not there is a contribution to wellbeing or progress. As long as the GDP is rising, it is assumed that both development and social progress are rising along with it. The "Beyond GDP Movement" has emphasized the failure of this approach and the need to develop more integrative, equitable and balanced approaches to measuring wellbeing. Policymakers are paying greater attention to the idea that broader measures than GDP should guide their decisions and a number of wellbeing indices have been developed as a result.

The role of the natural environment in these indices has been slow to evolve and the question of how sustainable development or progress can be measured correctly is one question that has yet to be answered. It is important to understand the role that the environment plays in our understanding of wellbeing and it is important to develop indices that depict it in a way that is

understandable to those who are interested in developing policies to enhance wellbeing. The question of sustainability also needs to be addressed in a broader way than just the maintenance of current ecosystem services. It is not just the environment that needs to be sustained, but also the entire social system.

The move towards measuring progress in a holistic manner has resulted in the creation of a number of wellbeing indices that attempt to measure wellbeing with a number of important variables that go beyond economic growth. Incorporating the environment and sustainability into these indices has proven to be crucial, yet problematic. Human development and social progress are dependent on a healthy environment, but how to define and measure this presents several problems. A number of wellbeing indices were developed to compare countries on various measures of wellbeing in a way similar to the way in which the GDP compares the economic progress of countries. The most widely recognized of these is the Human Development Index (HDI) created by the United Nations Human Development Programme (UNHDP). The HDI defines development as a process of enlarging people's choices and measures health, education and access to resources (UNHDP, 2014). There have been several attempts to address issues of the environment and sustainability within the HDI, but these have not been entirely successful. Sustainability has been the focus of the development of the OECD Better Life Index, which has attempted to measure the sustainability of 34 countries considered to be advanced in global development, including those in which environmental issues play an important role (OECD, 2011). Neither of these has however been accepted as well as the GDP has been when it comes to measuring wellbeing, development or progress.

In an attempt to develop an index that would be perceived as being as informative and useful as the GDP especially when it comes to policy development, the Genuine Progress Indicator (GPI) integrates social and environmental concerns in order to create a more inclusive and expansive conception of progress (Talberth & Cobb, 2006). Like the GDP, it provides a simple way of viewing progress or development as a continuously rising or falling number. It is a one-dimensional index but it represents a multidimensional construct. Unlike the GDP, it places economic value on social and environmental factors that are not usually valued in the traditional marketplace (Talberth & Cobb, 2006). It is widely used to measure the health of a nation's economy by valuing certain human commodities. It rises and falls according to social and

environmental factors such as poverty rate and pollution levels and environmental impacts are treated much like economic impacts. The GPI has been used to compare wellbeing across nations; however, it has also been scaled to smaller regions and provides information on implemented policy projects and the improvements or losses that may result. Some of the problems associated with the use of the GPI involve the difficulty of comparing different countries or regions that have different cultural traditions, different values and concerns and different ideas about what constitutes wellbeing (Bleys, 2012). Culture plays an important role in determining aspects of wellbeing that need to be measured and addressed and the most well known attempt to measure wellbeing based on cultural principles, the Gross National Happiness Index (GNH) was created in Bhutan to define and measure quality of life or social progress based on Buddhist ideals. The GNH is considered to be so important to the people of Bhutan that the country's constitution requires that all new policies and programs created by the government must abide by its principles (Gross National Happiness, 2010).

1.2 The Canadian Index of Wellbeing

In Canada, attempts to define and measure wellbeing began in earnest in the 1990s and after several rounds of expert and stakeholder consultation, a list of "what matters most to Canadians" was developed. There was interest in constructing an index that measured wellbeing beyond simple economic progress, which included ideas about sustainability and could be applied at different policy levels and was distinctly Canadian. The Canadian Index of Wellbeing (CIW) was designed to create a one-dimensional index (similar to the GDP and GPI) to represent a multidimensional construct of wellbeing that is distinctly Canadian. The stated purpose of the CIW is to give warnings about aspects of Canadian development that could be in danger, to encourage policy makers to make decisions based on solid evidence and empower Canadians to advocate for change (Michalos, Smale, Labonte, Muharjarine, Scott, Guhn, Gadermann, Zumbo, Morgan, Moore, Swystun, Holden, Bernardin, Dunning, Graham, Brooker and Hymanin, 2011 p. 65). Wellbeing is conceptualized as a collection of eight elements (or domains): good living standards, robust health, vital communities, an educated populace, balanced time use, high levels of democratic participation, access to and participation in leisure and culture and a healthy natural environment (Michalos et al., 2011, p.2). Some domains were easier to develop than others and

the indicators of progress within them presented few problems. Many of the domains had the supporting data and were readily available, easily accessible, had good scientific backing, and could be readily applied in community settings. This was not the case with the Environment Domain; it presented with many technical challenges.

In 2012 the CIW reported that of the 8 domains identified two (Education and Living Standard) were increasing at the same rate as GDP, but 6 others (Community Vitality, Health, Democratic Engagement, Leisure and Culture, the Environment and Time Use) lagged behind with the Environment Domain suffering the most (Canadian Index of Wellbeing, 2012). All aspects of human wellbeing take place within an environment and yet for measurement purposes, the Environment Domain is just one of eight, existing on a par with Leisure & Culture and Democratic Engagement. The relationships between the Environment Domain and other domains have not been explored in detail, nor has the relationships between indicators in the domain been explored. As well, according to Michalos et al. (2011) there may be links in the form of causal interactions or correlations among indicators that may be housed in different domains. The relationships among indicators within domains and among indicators across domains still need to be explored. There is a need to know about the types of relationships that exist, the purposes of these relationships and their structure in order to gain a better sense of why numbers in the environment domain are dropping. There is also a need to incorporate more robust measures of perceptions. Explorations of these sorts are essential for adequate sustainability assessments because human motives, preferences, needs, perceptions, and evaluations can be either resources and/or constraints in terms of sustainability (Michalos, 1978). The quality of people's lives is not only a function of the objective conditions in which they live, but also what they make of those conditions. This depends on how the conditions are perceived (accurate or not) what is thought and felt about those conditions (how they are evaluated), what is done and finally what consequences follow from what is done (Michalos et al., 2011, p. 71).

1.3 Problem Statement and Research Question

There are special problems connected to the tasks of exploring, defining, measuring and developing sustainable wellbeing. One has to measure what one wants to sustain, what resources are required to sustain it and the rates of change of each relative to the other (Michalos et al., 2011,

p. 8). The wellbeing of a community cannot be adequately measured through statistical, technical, or scientific measures traditionally used to measure environmental impacts and sustainability. The relationship between wellbeing, the environment, and sustainability is a complex one that needs further development in the Canadian Index of Wellbeing. The measurement of environmental stress in the CIW has been problematic due to various limitations including data availability or accessibility; and because some indicators do not lend themselves well to a strict stock and flow framework, they remain only tools to indicate the current state of the environment making it difficult to determine how to improve it. Sustainability however, is considered a core value that drives the work of the CIW. Michalos et al. (2011) acknowledges that incorporating sustainability into the index remains problematic. The development of the Environment Domain in the CIW that takes into account its unique role in human wellbeing can create a better understanding of the relationship between wellbeing, the environment and sustainability. To that end the following research question was developed.

Research Question: How can the Environment Domain of the Canadian Index of Wellbeing contribute to an understanding of wellbeing and communicate strategies that promote strategic sustainable development?

In order to address the above research question, a qualitative, exploratory approach was undertaken. A review of the literature concerned with understanding the relationship between human wellbeing and the natural environment was initially conducted. A similar review of the development of various indices and the role of the environment within the indices was also conducted. The development of various environmental indicators and questions about the difficulty of incorporating measures of sustainability into indices were also reviewed and provided an academic base for the project. In order to understand the purpose, construction and use of wellbeing indices, interviews with key informants in the wellbeing field were conducted. In order to specifically understand the role of the Environment Domain in the Canadian Index of Wellbeing, key informants were selected based on their familiarity with the index. Planners within the City of Waterloo were also interviewed in order to gain an understanding of how useful indices like the CIW are in terms of policymaking. As a result of the interviews, additional literature in the field of systems analysis was reviewed in order to make specific recommendations for the Environment Domain. The DPSIR model and Material Flows Analysis were referred to specifically.

1.4 Theoretical and Practical Contributions

Research of this type has the potential to contribute to both academic and applied public sector approaches to wellbeing. By examining current frameworks used to explain the relationship between human behaviour and its effects on the environment as well as current approaches to measuring sustainability, the evolving and interdisciplinary field of sustainability and societal wellbeing research can be advanced. It can improve, direct and focus the Environment Domain in the CIW so it becomes more useful in informing the general public and selected stakeholders (including policy makers) about the relationship between human behaviour and changes in the state of the environment. It can contribute in a practical way to the development of the healthy communities approach to sustainable development. Suggestions made for the Environment Domain of the CIW can also be applied to other wellbeing indices that include environmental indicators. This thesis can provide the academic, private and public sectors with a basic understanding of wellbeing and how environmental indicators can contribute to sustainability planning and implementation. Because this study is descriptive and exploratory, it may be limited in use to the CIW or indices that are similar to it, but it may also serve as a starting point for the development of future long-term studies focused on improving both environmental sustainability and human wellbeing.

This thesis reviews the history of how and why the GDP, a widely accepted measure of economic progress may be incomplete when it comes to measuring human wellbeing. It explores the relationship between human activities and the possible detrimental effect that these activities can have on the state of the environment. This can have an impact on environmental sustainability as well as the preservation of resources for future generations. The Canadian Index of Wellbeing is an ongoing project that is constantly evolving. It is dedicated to measuring the wellbeing of Canadians within eight valued domains; one of which measures the state of the environment. This thesis aims to examine the environment domain and contribute to the evolution of the CIW by suggesting a new organizational model and the development of new tools to further expand and explain the relationship between human activity and the role of the environment in human wellbeing. Chapter 2 provides a review of the current literature on the use of the GDP as a measure human wellbeing, a review of some prominent international measures of wellbeing and a

discussion of the challenges involved in indicator development. It also explores the research on the relationship between the environment and wellbeing, the concept of sustainability and the importance of developing indicators that have applicability at the community level. Chapter 3 describes the design of the study, the selection of participants, the analysis of the data and the limitations and boundaries. Chapter 4 presents the data organized into prominent themes or areas of concern. Chapter 5 carries those themes forward into a discussion of how the Environment Domain can be developed in light of DPSIR and Material Flow Analysis. Chapter 6 concludes with a discussion of the importance of being able to use the Environment Domain for developing policy that is concerned with increasing wellbeing at the community or local level.

Chapter 2 Literature Review

2.1 Beyond GDP

Gross Domestic Product (GDP) is the measurement of the total dollar value of all goods and services produced in a country, typically measured on an annual basis. GDP comparisons between different years can give us an idea of how much Canadians are making and how much they are spending. Often when the GDP is in negative growth it indicates a coming recession. The GDP is the most well-known measure of economic performance in the world and since the late twentieth century, it has become a proxy measure for social progress and human wellbeing. According to the utilitarian approach, people are the best judges of their own wellbeing and an increasing GDP provides economic stability, which allows increasing numbers of people to determine their own preferences in their pursuit of wellbeing (Scott, 2012). Critics of the GDP say that there is an overwhelming assumption that wellbeing and GDP grow together (Sacks, Stevenson and Wolfers, 2013). Although the GDP was never meant to be a measure of wellbeing, an increasing GDP is thought to be related to increasing utility and has come to be used by policy makers as a sign of increasing human wellbeing (Scott, 2012). However, an increasing GDP does not necessarily mean that all members of society will experience increasing wellbeing. The GDP makes no distinction between economic activities that are believed to enhance wellbeing and those that are believed to be harmful. The GDP has been criticized for being prone to over-valuing material goods and the large-scale production and consumption of goods and services. It also fails to distinguish between money spent for new consumption and money spent to repair the negative effects of consumption. The GDP was developed to provide relevant quantitative information for policy makers about the state of the economy and according to Stiglitz, Sen and Fitoussi (2010) what we choose to measure and how we construct our measures plays a crucial role in the decisions that are made about our future.

In his report to the U.S. Congress in 1934, Simon Kuznets one of the early developers of the GDP himself said "…the welfare of a nation [can] scarcely be inferred from a measure of

national income…" (GPI Atlantic, 2007). The relationship between welfare (an early term for wellbeing) and income is a complicated one and may be affected by the state of a country's development. In 2009 the President of France, Nicolas Sarkozy and a commission of the world's leading experts led by Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi called for a "politics of civilization" to address pending global crises related to climate change, hunger and poverty.

> *… if we remain locked into an index of economic progress that includes only what is created and not what is destroyed; if we look only at gross domestic production, which rises when there has been an earthquake, a fire or an environmental disaster; … how can we expect to realize what we are really doing and face up to our responsibilities?* - Nicolas Sarkozy, 2010 (Stiglitz, Sen & Fitoussi, 2010).

Wellbeing in underdeveloped nations may be dependent on rising income, but in developed nations, this relationship is less certain. Growth in affluence for very low-income countries can substantially improve wellbeing but this benefit rapidly diminishes, so that for affluent countries further economic growth does little to improve wellbeing (Dietz, Rosa & York, 2009). It has been observed that once a certain GDP is reached, the strength of the relationship between income and reported levels of wellbeing declines markedly. According to Dietz, Rosa and York (2009) improvements in wellbeing from growing affluence are best characterized as a relationship of diminishing returns. The relationship between affluence and wellbeing appears to be curvilinear with higher levels of income contributing less and less to wellbeing (Knight & Rosa 2011). Although there appears to be a significant association between higher GDP and standard of living and happiness, it has been argued that this relationship has a threshold. Based on subjective survey data, the Easterlin Paradox suggests that beyond a basic level of income, incremental increases in income do not lead to increases in life satisfaction and economic growth over time does not lead to higher wellbeing in either developed or developing countries (Easterlin & Angelescu 2009). Although individuals in developed countries may report both higher levels of subjective wellbeing and better health, certain facets of wellbeing respond less well to income than other variables (Deaton, 2008). For various measures of wellbeing, economic growth has no robust effects, it becomes less effective over time and factors other than economics such as fertility rates, urbanization and education are more influential in predicting wellbeing in less developed countries (Brady, Kaya & Beckfield, 2007).

Maslow's Hierarchy of Needs (1943,1954) suggests that human needs are universal. Some needs like food and shelter must be satisfied before others like love, self-esteem and self-actualization can be addressed. In order for a society to direct its energies towards the satisfaction of its citizens' higher order needs, it must first be able to satisfy its citizen's needs for food and safety. A certain level of economic progress and development are necessary for the satisfaction of basic physical needs. At the most basic levels of development, all citizens must be able to enjoy physical health and safety from harm. Early anthropological theory has suggested that cultures evolve much as species do. Darwinism suggests that species evolve and develop in a uniform and progressive manner and arrive at a 'common end'. Higher forms of human social progress evolve from and surpass lower forms (Ember, Ember, & Peregrine, 2010, p. 23). Edward Tylor (1832-1917) proposed that human culture started simple and became progressively more complex through three stages, savagery, barbarism and civilization and progress is possible at each stage (Ember, Ember, & Peregrine, 2010). Tylor acknowledged that different societies could be at different stages of evolution at the same time and that there was a 'psychic unity' among all human beings that gave them all a similar evolutionary path amongst different cultural traditions. According to Ember, Ember and Peregrine (2010) "different societies often find the same solutions to the same problems independently" (p.18). The evolutionary nature of humans is destined to follow a progressive path, no matter what level of development has been achieved. Once human needs for food and safety have been satisfied, wellbeing becomes more dependent on the satisfaction of needs for love, self-esteem and self-actualization. For an affluent, developed country like Canada, rising GDP may not be an adequate indicator of rising wellbeing.

2.2 Measuring Wellbeing

Wellbeing is subjected to and shaped by cultural context. Social norms and institutions influence groups and their ideas about what wellbeing means and what factors are influential in increasing wellbeing. The factors that are perceived to be influential will vary across countries based on culture and level of economic development. The terms quality of life, happiness, prosperity, human development, life-satisfaction and wellbeing are all used interchangeably when discussing what brings meaning to human life. Although many attempts have been made to explain and define the concept of wellbeing, the complex nature of the term means a common definition

has not yet been found and according to Scott (2012) a common definition is needed to support strategic decisions by policy makers while preserving the rights of people to decide how they want to live their lives (p. 15).

There appear to be two distinct ways of viewing and measuring wellbeing: objective wellbeing, which is something that can be observed and easily measured like economic wealth and physical health and subjective wellbeing, which is based on individual experience and perception and this can vary widely across individuals and cultures (D'Acci, 2011). Standard economic theory tends to favor an objective perspective based on the choices that individuals make and how these choices affect the greater system (Frey & Stutzer, 2002). There are those that believe human choice is the only aspect of wellbeing that can be observed. Economists tend to view all others as being subjective and therefore irrelevant (Frey & Stutzer, 2002). From a systems perspective, the structure of one's surroundings determines behaviour and therefore not all choices may be voluntary or well informed.

The subjective experience of an individual's perception of wellbeing tends to be viewed as "unscientific". According to Bleys (2012) the objective approach to wellbeing uses "hard" (direct) data like income per capita or literacy rates, while the subjective approach uses "soft" (indirect) data such as the way people report feeling about their income or whether or not they have achieved satisfaction from their education. It is often believed that hard or quantitative data is more valid and reliable especially if it is collected from reputable sources because it does not require interpretation while soft or qualitative data usually collected through surveys and interviews requires too much interpretation, which can hinder both its reliability and validity (Bleys, 2012). If absolute income as a measure of wellbeing influences subjective perceptions of wellbeing then a measure that focuses solely on income is not without merit as long as the subjective aspects of wellbeing are acknowledged. What people think about how much income they make has a bearing on how they perceive their wellbeing. Both the objective and subjective approaches have advantages and disadvantages. Veenhoven (2002) explains that the validity of either objective or subjective measurements must be based on their substance and assessment. According to Bleys "the substance relates to the question of what is being measured, while the assessment refers to the actual process of collecting the data" (2012, p. 361).

2.3 The Canadian Index of Wellbeing

In Canada, in the 1990s, there was interest in creating a uniquely Canadian index that could measure wellbeing. The Canadian Index of Wellbeing (CIW) was designed to create a one-dimensional index to represent a multidimensional construct of wellbeing that was distinctly Canadian. It recognizes that many Canadians are struggling to gain benefits from GDP growth and because the GDP was never designed to measure the impact of economic growth, the CIW was designed to shed light on practices that might be socially and environmentally unsustainable. According to the CIW approach, Canadian wellbeing can be categorized as a collection of eight elements (or domains): good living standards, robust health, a sustainable environment, vital communities, an educated populace, balanced time use, high levels of democratic participation and access to and participation in leisure and culture (Michalos et al., 2011).

The CIW defines wellbeing as "The presence of the highest possible quality of life in its full breadth of expression focused on but not necessarily exclusive to good living standards, robust health, a sustainable environment, vital communities, an educated populace, balanced time use, high levels of democratic participation, and access to and participation in leisure and culture" (Canadian Index of Wellbeing, 2009). The CIW is described as being bidirectional in its attempt to build a conceptual framework and pragmatic in that it makes use of existing data (Michalos et al., 2011). It uses an anthropocentric perspective meaning that only things that are important to Canadians are included. This was determined through a number of cross country presentations, consultations, workshops and focus groups. Many of the domains and indicators that evolved from this process were matched against data from Statistics Canada's National Population Health Survey (Michalos et al., 2011). Eight interconnected domains with 64 headline indicators were created. The CIW Technical Paper (2011) describes as a Mandela with three concentric circles surrounding wellbeing at the core. The circles represent the resources that Canadians draw upon for wellbeing. The personal resources (or domains) in the first circle are healthy populations, education and time use. Public resources such as living standards, community vitality, leisure and culture and democratic engagement are in the second circle. Ecosystem or environmental resources are in the outer circle and affect all other circles and domains. Measurements of each indicator within each domain were combined into a composite index and a mean of percentage change rate

ratios scale was developed. The CIW is a compensatory scale because it allows tradeoffs between deteriorations on some indicators to be compensated for by improvements in others (Michalos et al., 2011). Because it was believed that the greater the variety of weights assigned to the CIW, the less useful the index would be as a common or generally accepted measure of wellbeing, the Principle of Nonsufficient Reason was used to justify the equal weighting of indicators (Michalos et al., 2011). According to Michalos et al., (2011) although it is assumed that there is interaction among all elements in the circles, all constituents and determinants are not yet known. Many elements of the system are both constituents and determinants and many are both means and ends regarded from different perspectives.

Critics say that while Canada initially was an early pioneer in advancing alternative wellbeing frameworks, development here appears to be at a standstill while development in other countries has advanced (Wilson & Tyedmers, 2013). The relationships between indicators and domains, subpopulations, demographics and geography still need to be explored by the CIW. There is a need to know about the types of relationships that exist, the purposes of these relationships and their structure (Michalos et al., 2011, p. 63). There is also a need to incorporate more robust measures of perceptions within the CIW. The quality of people's lives is not only a function of the objective conditions in which they live but what they make of those conditions. This depends on how the conditions are perceived (accurate or not) what is thought and felt about those conditions (how they are evaluated), what is done and finally what consequences follow from what is done (Michalos et al., 2011, p.71). There is limited information when it comes to the terminology and methods used in wellbeing and quality of life metrics; complex terms such as wellbeing, progress and sustainability are used interchangeably and are rarely given a definition. Wilson and Tyedmers (2013) suggest that the long history of these terms has caused fuzziness and the brand new nature of metrics like the CIW remain evolving concepts and the lines between their terminology and application tend to be blurred. Some domains may have a bigger impact on overall wellbeing than others and this needs to be accounted for in index development.

2.4 Global Indices

Throughout the literature there are wellbeing indices that stand out. These indices are all dedicated to improving the statistical measurements of wellbeing and filling the gap between the

standard economic statistics and indicators that have a more direct effect on peoples' lives. The Human Development Index, the OECD Better Life Index, Bhutan's Gross National Happiness, and the Genuine Progress Indicator have all been developed to measure human wellbeing beyond the constraints of the GDP.

2.4.1 Human Development Index

The Human Development Index (HDI) created by the United Nations Human Development Program may be one of the most well known indices that measure human progress in the world. It is the product of a well-known, important international organization and was created to address some of the most devastating issues facing the global community. The HDI is concerned with sustaining human progress by reducing vulnerabilities and building resilience in the areas of health, education and living standards. The HDI uses a straightforward framework for measuring human development with dimensions and indicators creating "dimension indexes". Health is measured by life expectancy at birth; education is measured by mean of years of schooling for adults aged 25 years and older and expected years of schooling for children of school entering age. Living standard is measured by gross national income per capita.

The first HDI report was released in 1990 by the United Nations and since then the HDI has monitored trends in global progress from 1980 to 2013 (United Nations Human Development Programme, 2014). According to the 2014 HDI Report, crises will always occur, it is how communities can adapt and prepare for these crises that is important to determine (Malik, 2014). The HDI is currently focused on improving conditions for vulnerable people, those living in extreme poverty, by measuring life cycle vulnerability, structural vulnerability and insecure lives. Other areas of concern include the responsiveness of institutions to provide jobs, health care and education opportunities for the poor and the capacity of communities to prepare and recover from crises. Information from the HDI is also used in conjunction with that from the Gender Inequality Index (GII), Multidimensional Poverty Index (MPI) and Gender Development Index (GDI) (UNHDP, 2014). Information from the HDI has also been used to describe the slowdown in the economies of developed countries, and the increasing pace of the economies of developing economics, which they call "the rise of the south" in their 2013 report (UNHDP, 2014). According

to the developers of the HDI what is needed on a global level is nothing short of a full transformation that promotes human development by universalizing access to basic services.

2.4.2 OECD Better Life Index

The Organization for Economic Co-operation and Development is an international economic organization comprised of 34 developed countries concerned with the promotion of economic progress and trade (OECD, 2011). Criticisms directed toward the organization have been based on its composition. It only includes rich nations. However this unique group of countries has been the focus of how economic growth can be connected to or result in divisive global issues such as poverty and climate change (Christians, 2008). The OECD developed the Better Life Initiative in 2011 to "identify the best way to measure the progress of cities" (OECD, 2011, p. 1). The report "How's Life" and the Better Life Index focused on how progress was achieved in developed countries. The Better Life Index is an "interactive tool" comprised of 11 dimensions considered to be essential to wellbeing; community, education, environment, civic engagement, health, housing, income, jobs, life satisfaction, safety and work-life balance. The interactive online tool provides a unique subjective perspective of how people value the 11 dimensions. The index is updated every year with new data and covers all 34 OECD countries (OECD, 2011).

2.4.3 Gross National Happiness

One of the most well-known indices of wellbeing is one that is unique to a specific country and culture. In Bhutan, the Gross National Happiness Index (GNH) was created to define and measure quality of life or social progress in holistic terms based on Buddhist ideals. Bhutan's unique culture defies comparison and progress or development of that culture is believed to be unique which makes comparisons to the development of other countries virtually impossible. Although the framework of the GNH is similar to that of other wellbeing indices progress is viewed from a uniquely holistic perspective based on Buddhist principles (Gross National Happiness, 2010). The four pillars of the index are the promotion of sustainable development, the preservation and promotion of cultural values, the conservation of the natural environment and the establishment of good government (Gross National Happiness, 2010). Contributors to the pillars

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are believed to be physical, mental and spiritual health, time balance, social and community vitality, cultural vitality, education, living standards, good governance and ecological vitality (Gross National Happiness, 2010). Although the Index has been criticized for its reliance on subjective interpretations of wellbeing, the GNH combines both objective and subjective measures based on cultural values and perceptions. The index includes nine domains with 33 indicators based on 124 variables (Gross National Happiness, 2010). The data is categorized into district, gender, age and rural-urban residence and then decomposed into sub-national levels and examined for citizen needs (Gross National Happiness, 2010).

2.4.4 Genuine Progress Indicator

In 1968 Arnold Sametz called for an adjusted GDP to overcome the constraints shown with assessing social progress solely through economic metrics and in 1973, a Measure of Economic Welfare was created, which eventually evolved into the Index for Sustainable Economic Welfare during the environmental movement (Clarke & Lawn, 2008). During this period, the term 'welfare' became popular among academics looking to define what they were looking to measure and economic wellbeing or welfare came to be perceived as the difference between the benefits and costs of economic activity (Clarke & Lawn, 2008, p.573). By the early 1990s, there was some discussion in the human development and ecological economics fields that monetary growth might actually be contributing to a loss not an improvement in human wellbeing. The Genuine Progress Indicator (GPI) developed by the Centre for Sustainable Economy as an addition to the national system of accounts was designed to measure the impact of production on society and the environment. The GPI was designed to measure the impact of a growing economy on the wellbeing of society and the environment as well as the social and environmental costs associated with growth (Clarke & Lawn, 2008). It measures the health of a nation's economy by valuing certain human commodities. It rises and falls according to social and environmental factors such as poverty rates and pollution levels and environmental impacts are treated much like economic impacts. While it continues to consider standard economic growth, the results are dependent on values that typically escape market valuation (Clarke & Lawn, 2008).

Since its initial development, the GPI has been applied at a national level to both developed and developing countries as well as at a sub-national level like GPI Maryland, GPI Atlantic, and

GPI 2.0. The easy application of the GPI is considered to be one of its best attributes when compared to other indices and it appears to have had some influence on the agendas of state policy officials. Although there have been doubts about the GPI's direct influence on policy, its indirect influence may be the encouragement of debate about plans for long-term development and this impact may be significant enough to result in the consideration and possible development of anti-growth policies (Clark & Lawn, 2008). Clark & Lawn (2008) argue that by defining development beyond income, the GPI has the ability to encourage alternative development. Criticisms of the GPI include its lack of theoretical foundation, as well as the way indicators are valued within the index. Like other well-known indices, the GPI is a composite index and adjustments to it are based on value judgments. The determination of the GPI's final number is dependent on values, choices and preferences in the methods chosen for cost benefit values and this makes comparisons among countries difficult (Clarke & Lawn, 2008).

Nova Scotia was one of Canada's first regions to apply the GPI. The GPI was considered to be a basic, flexible method for measuring progress and wellbeing (Colman, 1998). The GPI Atlantic was based on the same accounting practices and methods of sustainable development and a three-stage process was used to develop the index (Colman, 1998). First a basic framework was developed. Indicators were then selected and prioritized. Appropriate valuations were determined and methodologies were selected for each indicator (Colman, 1998). The preliminary criteria for assigning indicator weights in the GPI Atlantic was based on the idea that any indicator that measures a gain in wellbeing for one community as a corresponding loss in another should be excluded in order to establish 'net' overall benefit to the indicators (Colman, 1998). Indicators that were chosen had to pass the "equity test". For instance, a decline in crime or sickness had to produce a net gain in wellbeing without a corresponding loss elsewhere (Colman, 1998, p.19). Colman acknowledges that this process is very difficult to achieve at an international level where lending and borrowing results in both gains and losses in different countries (1998).

2.4.5 Australian National Development Index

The Australian National Development Index (ANDI) is the newest of the national indicators and is based on *Measures of Australia's Progress*, which uses 17 indicators across a range of domains within a dashboard format (Australian National Development Index, 2014). The ANDI is a proposed composite index, similar to the Canadian Index of Wellbeing reflecting the views and priorities of its citizens while focusing on economic, social and environmental progress. The idea of the ANDI came from the Australian 2020 Summit in April 2008 and was endorsed by the Australian Government (ANDI, 2014). It is not yet known when the ANDI will be completed, however its framework is comprised of 12 domains spanning a 3-year period and its goals are to emphasize research, community engagement and knowledge mobilization (ANDI, 2014).

2.5 Indicator Development

Initially, wellbeing indicators were developed as a response to the perceived inadequacies of the GDP as a measure of social progress. The concept of wellbeing is embedded in the belief that progress for human beings means more than economic stability and growth. Social progress beyond economic growth is needed for people to achieve positive wellbeing.

In 2007 the European Commission, the Organization for Economic Cooperation and Development, the Organization of the Islamic Conference, the United Nations, the UNDP and the World Bank signed the Istanbul Declaration (Wilson & Tyedmers, 2013). The declaration states that there must be high priority placed on measuring societal progress in every country, while acknowledging the fact that different ideas of what constitutes progress and different methodologies will be used (Istanbul Declaration, OECD, 2007). It calls on public and private organizations, academic institutions and community representatives to work together in order to provide "high-quality, fact-based information that can be used by all of society…" as well as encouraging governments to invest the resources necessary to develop reliable indicators of progress (Istanbul Declaration, OECD, 2007 p. 1). In 2009, the OECD created the "Measuring the Progress of Societies" website, which allowed practitioners and academics to collaborate and discuss their experiences with the development of wellbeing measurement tools (Bleys, 2012). In

2010, the Stiglitz-Sen-Fitoussi Report conducted by the Commission on the Measurement of Economic Performance and Social Progress outlined three important concerns with the measurement of wellbeing; classical GDP issues, quality of life and sustainable development and the environment.

The Stiglitz-Sen-Fitoussi Report is often refered to when comparing sucessful and unsuccesful indices. Stiglitz, Sen, & Fitoussi (2010) categorized existing wellbeing indicators in order to distinguish one framework from another. Categorizing indices allows for a better understanding of the purposes for which an indicator was created and the type of information it was designed to provide. There are large and eclectic dashboards, which take a widespread heterogeneous approach and use both direct and indirect methods to measure the relationship to socio-economic wellbeing. The United Nations Human Development Index (HDI) and the OECD Better Life Index are considered large and eclectic dashboards (Stiglitz, Sen & Fitoussi, 2010). According to Hancock (1993), the integration of health, environment and the economy was at the forefront of indicator development and influenced the production of the Human Development Index in 1990. In the HDI, human wellbeing is defined as the extent to which individuals have the ability to live the kind of lives they value, and the opportunities they have to achieve their potential and wellbeing is measured by a long and healthy life, knowledge and a decent standard of living (UNDP, 2014). Composite indices were developed as a way to compress overwhelming, yet relevant information into a single number (Stiglitz, Sen, & Fitoussi, 2010). The OECD Better Life Index employs a composite index with 11 multidimensional categories. Composite indices address the initial problems typically raised in large dashboards, yet they can be ambiguous in nature and typically require background information to better understand them (Stiglitz, Sen, & Fitoussi, 2010). According to Bleys a fundamental problem with the Stiglitz-Sen-Fitoussi Report is that it does not give enough attention to economic welfare. Even though the report clearly explains problems with the current way economic wellbeing is measured, it does not acknowledge that it is still important to include economic wellbeing in a hollistic measurement of wellbeing (Bleys, 2012).

According to Bleys (2012) development issues covered by the indices reviewed in the Stiglitz-Sen-Fitoussi Report and reviewed by Bandura had moved from traditional economic issues to concentrate on social and environmental issues (Bleys, 2012). According to Bleys, both origin-

based and objective-based classification schemes are problematic. The origin-based schemes group indicators based on academic field such as economics, psychology or sociology and tend to oversimplify the interdisciplinary nature of wellbeing (Bleys, 2012). They do not acknowledge the complexity of the field and they tend to overlook environmental sustainability indicators (Bleys, 2012). Objective-based schemes examine the reasons why specific indicators were created and what they were meant to address, rather than what they are able to address (Bleys, 2012). They also tend to focus on the GDP as a genuine measure of progress when the GDP does not represent a complete picture of human wellbeing or economic welfare (Bleys, 2012).

In 2005 and 2008, Bandura reviewed the most widely used composite indicators that measure country performance. The aim of the review was to identify indices that rank or assess country performance in a diverse set of areas including competitiveness, governance, social aspects, human rights, the environment, security and globalization (Bandura, 2008, p.6). In creating an inventory of current indices using organization websites, reports, methodology and frequency of issuance, Bandura found common trends in both the quantity of indices becoming available and the variety of issues plaguing each one (Bleys, 2012). Bandura found that the rankings and assessments examined in the reports were elaborated using a single indicator with approximately 80% of the indices having been elaborated in the 1991-2005 period and almost half of those available in 2005 developed after 2000 (Bleys, 2012, p. 356). Although a number of alternative measures are currently available, composite indicator research focuses on how to develop and promote individual indicators rather than the development and improvement of those already available. Bleys suggests that this is why few classification schemes of alternative measures currently exist (2012). The objective of a classification scheme is to organize different indicators and indices efficiently so they are focused on a country's economic, social and environmental performance (Bleys, 2012). Instead of creating a framework for an entire country that has already selectively chosen the best-suited indicators, policy makers should be able to select indicators based on the specific progress target at that time.

2.6 The Role of the Environment in Wellbeing Measurements

There is a considerable body of research that suggests that the environment has an important impact on human health and wellbeing. The environment is perceived to be an important

component of all currently developed indices of wellbeing but how it is conceptualized and measured varies with each index. Some indices view wellbeing from an economic approach such as 'economic wellbeing' and some are only concerned with measuring changes to environmental aspects like the Ecological Footprint. The environment is also sometimes just added to a range of other social factors as a category within a larger picture (Gadrey & Jany-Catrice, 2006).

After the World Bank published "Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development" in 1997, Canada integrated the new Canadian System of Environmental and Resource Accounts with their national balance accounts (Colman, 1998). This transition moved Canada's accounting system to a more environmentally adjusted GDP or "Green GDP" (Colman, 1998). The relationship between wellbeing and sustainable development was becoming more apparent through new methods of accounting for sustainability. The GDP acknowledges short-term growth, however, according to Colman "economic activity is valued according to long-term qualitative environmental, social and lifestyle standards" and progress and wellbeing may well depend on the limitations of growth rather than unlimited economic expansion (1998, p. 3). Sustainable Development first showed legal president in Canada in 1997 when it was required of each federal government department to submit a Sustainable Development Strategy to the Office of the Commissioner of the Environment and Sustainable Development (Colman, 1998). These strategic submissions were to be met with suggested measures and indicators of sustainability (Colman, 1998). At this time, the development of the Canadian Index of Wellbeing was already underway and the environment was considered to be an important component of human wellbeing. The relationship between the environment and human wellbeing has been well accepted by the general public and has been an important area of research in a number of academic disciplines.

2.6.1 The Environment and Human Health

In 1946 the World Health Organization declared that health must be "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (Hoernig & Seasons, 2004). There appears to be an innate human affiliation to nature and the lack of interaction with nature has a profound impact on our physical and emotional health (Wilson, 1984, 1993; Louv 2008). According to Kellert and Wilson (1993) appreciation of biodiversity is

embedded in our biology and nature is essential for our health and development. According to Murat (2014) there appear to be direct pathways by which such experiences affect the central nervous system, bringing about stress reduction and restoration of attention. Natural environments may be lower in environmental "bads" such as air pollution that have negative impacts on physical and mental wellbeing and natural environments can potentially increase happiness by facilitating and encouraging behaviours that are physically and mentally beneficial (physical exercise, recreation and social interaction).

According to the United Nations Environment Programme (UNEP, 2007, p. 310) the link between the environment and wellbeing is

> "... complex, non-linear and influenced by multiple factors, including poverty, trade, technology, gender and other social relations, governance and the different aspects of vulnerability. Global interconnectedness- through a shared natural environment and globalization – means that achieving human well-being in one place may be affected by practices elsewhere."

Stern (1993) calls for a "second environmental science" focused on interactions between humans and the environment and questions the forces that drive human activities that contribute to environmental degradation including alterations in social institutions, human values, economic development and population growth. There is a need to study the ways individuals, organizations and governments act on the basis of experienced or anticipated environmental change to manage human activity and preserve environmental values (Stern, 1993, p. 1897).

According to Davis, Lee & Coy (2011) the person-environment relationship is bidirectional; just as human behaviour affects the wellbeing of the environment, changes in the environment affect human wellbeing (p. 257). Despite the fact that environmental health and ecological sustainability are collective issues, individuals carry out environmental behaviours, individuals support sustainability policies and individuals need to be motivated to act responsibly (Nisbett & Gick, 2013). Certain behaviours benefit society as a whole but do not always benefit the individual performing them. In recent years several constructs based on the wellbeing environment relationship have been developed including Connectedness to Nature (Mayer and Franz 2004); Commitment to Nature (Davis, Green and Reed, 2009) and Nature Relatedness (Nisbett, Zelinski & Murphy, 2009; 2011). According to Mayer and Frantz (2004) Connectedness to Nature (CTN) is an important predictor of environmental behaviour (identifying oneself as an environmentalist,

performing pro-environmental behaviours) and subjective wellbeing indicated by life satisfaction and positive emotions (Mayer & Frantz 2004). CTN predicts both life satisfaction and positive affect (Mayer & Frantz, 2004; Howell et al 2011). Commitment is positively associated with willingness to sacrifice and foregoing one's immediate self-interests to promote the wellbeing of others. When confronted with day-to-day environmental dilemmas, willingness to sacrifice for the environment represents the extent to which individual's decisions will take into account the well-being of the environment, at the expense of immediate self-interest, effort or costs (Davis, Lee & Coy 2011 p. 259). Nature Relatedness (NR) describes the affective, cognitive and experiential aspects of human-nature relationships and individual differences are associated with wellbeing. It also predicts membership in environmental organizations, self-identification as an environmentalist, and preference for green products (Nisbet, Zelinski & Murphy, 2011).

2.6.2 Ecosystem Services & the Millennium Ecosystem Assessment

Dr. Bill Freedman of Dalhousie's Biology Department argues, "environmental quality can be considered an inherent or intrinsic value, aside from its impact on the human economy" (Colman, 1998, p.19). However, Colman argues that "an index that incorporates benefit cost analysis and assigns monetary values must attempt to trace economic-ecological interactions, even if only for policy purposes" Colman, 1998, p.19). The International Society for Ecological Economics has proposed that the value of environmental quality can be measured by the amount of investments in natural capital (Colman, 1998). This way of thinking views environmental protection as a capital investment designed to "ensure the continuation of a high quality of essential services" (Colman 1998, p. 20). These essential services can be shown to improve wellbeing, however the cost of these services from a long-term perspective triggers debate. Do we need to show the economic cost of environmental degradation when measuring wellbeing? To what degree do these investments correspond to rising wellbeing?

According to Villamagna and Giesecke (2014) ecosystem services are commonly defined as the benefits people receive from ecosystems and these benefits are believed to contribute to human wellbeing, however the link between services and human wellbeing remains complex and difficult to quantify. The Millennium Ecosystem Assessment (MEA) was created to meet the needs of decision-makers for information on the links between ecosystem change and human wellbeing.

It assumes that the main components of human wellbeing can be linked to the status of the environment and defines wellbeing as a combination of freedom and choice, health, good social relations and security that reflects local geography, culture and ecological circumstances (Millennium Ecosystem Assessment Board, 2005, p.3). The constituents of wellbeing are situation-dependent, reflecting local geography, culture and ecological circumstances (MEA Board, 2005 p.8). Human wellbeing and progress towards sustainable development are dependent upon the Earth's ecosystems and nonmaterial benefits such as culture, education and recreation, which are all provided by ecosystems. Changes in the availability of natural resources can affect different aspects of human wellbeing including economic growth, health and livelihood (MEA Board, 2005 p. 27). Management of the relationship between ecosystem health and human wellbeing is needed to enhance the long-term capacity of the earth's natural resources for future generations. The link between the two must be recognized at the international, national and regional levels by policy makers in a position to implement change. *"Human well-being and progress towards sustainable development are vitally dependent upon Earth's ecosystems"* - (MEA Board, 2005 p. 26)

According to the MEA 2005 Report, human activity is having a significant and escalating impact on the biodiversity of world ecosystems, reducing both resilience and biocapacity. Of 24 ecosystem services assessed over a 50-year period, four showed improvements, five were considered stable and 15 were described as being in serious decline. During this time, human activity has had a greater impact on ecosystems than in any comparable time period. The changes that have been made to ecosystems have contributed to substantial net gains in human wellbeing and economic development, but these gains have been achieved at growing costs to ecosystem services and increases in poverty for some groups of people. Degradation of the environment is seen as a barrier to achieving the Millennium Development Goals of reducing global poverty, famine and disease. Human actions are putting such strain on the environment that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted. The report concluded that this process will accelerate as humanity's need for resources grows. The below schematic shows the ecosystem services and their relationship with human wellbeing according to the Millennium Ecosystem Assessment framework.
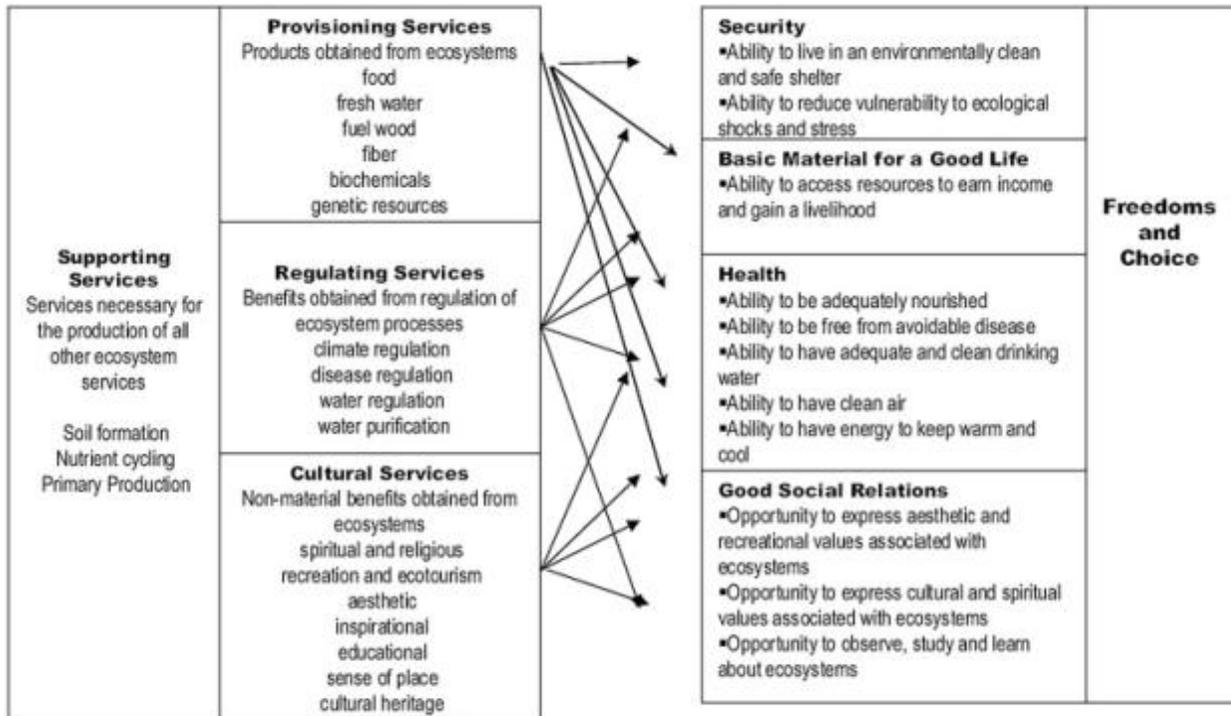
(Millennium Ecosystem Assessment Board, 2005, p. 5).

2.7 Sustainable Development

Pearce, Atkinson & Hamilton (1998) suggest "sustainability is a property of the path the economy is on and not of the state of the system at any given time" (p. 62). According to the 2005 United Nations World Summit on Sustainable Development there is a need to

> *Reverse the current trend in natural resource degradation as soon as possible, it is necessary to implement strategies which should include targets adopted at the national and, where appropriate, regional levels to protect ecosystems and to achieve integrated management of land, water and living resources, while strengthening regional, national and local capacities* (MEA, 2005 p. xi).

The conceptual framework of the Millennium Ecosystem Assessment acknowledges the importance of harmonizing ecosystem services with human needs. *"People make decisions concerning ecosystems based on considerations of well-being as well as intrinsic value"* (MEA Board, 2005 p. 7). Many factors independent of the environment change the human condition and many natural forces influence ecosystems (MEA Board, 2005, p. 8).

2.7.1 Sustainability and Material Consumption

The consumption of domestic and imported materials plays an important role when discussing sustainability because there is assumed to be a strong relationship between consumption and utility or wellbeing (Knight & Rosa 2011, p.931). The utilitarian paradigm assumes that the value of the environment is based on the fact that human beings derive utility from it. Utilitarianism suggests that the choice to use a resource lies within its function and the goal of social progress is to ensure the greatest quality for the greatest number of goods, consumed by the greatest number of people (Bleys, 2012). However, according to Knight and Rosa (2011) high consumption levels are not necessary conditions for high levels of wellbeing. Sustainable consumption can mean either consuming less or consuming differently and countries vary widely in how efficient they are in transforming environmental consumption into human wellbeing (Bleys, 2012 p.938). Increased consumption does not lead to higher levels of wellbeing in high consumption countries and countries with high levels of wellbeing vary greatly in their levels of consumption (Bleys, 2012, p. 934). One of the strongest predictors of national-level life satisfaction is high levels of social capital and countries with high levels of social capital may be able to meet some needs through social relationships thereby reducing material consumption and boosting life satisfaction by reinforcing social participation (Knight & Rosa, 2011, p.941).

Most efforts to operationalize sustainable development focus on developing human wellbeing while sustaining the environment and according to Dietz, Rosa & York (2009) it might be fruitful to investigate measures of environmental efficiency in producing human wellbeing or efficient well being. The Efficient Well-Being approach examines nations that are most and least efficient at producing wellbeing, "focusing sharply on the relationship between environmental inputs and human wellbeing outputs" (Dietz et al., 2009, p. 117). The environmental efficiency with which wellbeing is produced increases with affluence at low to moderate levels of economic development but declines at high levels. In the words of Dietz et al., (2009) "core theory and major international assessment efforts suggest that human impact on the environment is not driven by ignorance or carelessness but by the advantages derived from exploiting the environment" (p. 116). Dietz et al., suggest that instead of looking at how sustainable a social system can be, we should be looking at the ability of a community to produce true wellbeing (p. 120). If governments

focused more on improving wellbeing directly rather than indirectly through increased income and consumption, high levels of wellbeing might be attainable. Policies designed to alleviate economic inequality may help to move countries toward sustainability because countries that are more egalitarian are able to achieve higher levels of wellbeing with lower levels of environmental consumption (Knight & Rosa, 2011, p. 945).

2.7.2 The Triple Bottom Line

When discussing the natural environment and its relationship to human society, the environment is often perceived as a separate scientific category removed from human life and activity. According to Allin (2007) a more manageable framework appears from the context of sustainable development in which economic, environmental and social issues and progress are seen to be interdependent (p. 47). Defining sustainability often includes the idea of a triple bottom line or the notions of "strong" and "weak" sustainability. Bleys (2012) argues that in order to determine whether or not the present state can be sustainable over time, thresholds need to be defined for all indicators that attempt to measure the triple bottom line (2012); he also argues that debates surrounding sustainability derive from different ideas with regard to the substitutability between different types of stocks (2012).

According to Vemuri and Costanza (2006) natural capital has a unique relationship with life satisfaction that is not compensated for by any other variable. Engelbrecht (2009) has explored bivariate macro level wealth-happiness relationships across countries, focusing on total wealth and its three major subcategories (natural, produced and intangible) as measured in the Millennium Capital Assessment. Brown and Kasser (2005) provide micro-level evidence from the U.S. that suggests subjective wellbeing and ecologically responsible behaviour are positively correlated, implying that a sustainable way of life might not require a sacrifice of happiness and might actually enhance both personal and collective wellbeing. Ferrer-i-Carbonell and Gowdy (2007) found robust correlations between individuals' subjective wellbeing and their environmental awareness. They found that caring about positive environmental features has positive effects on wellbeing. Zidansek (2007) found that happiness and sustainability go hand in hand. Bley suggests the notion of economics and social systems being subsystems of the larger global environment is central to an ecological view of sustainable development (2012). According to this view, he explains

"sustainability in the economic and social spheres is subordinate to sustainability of the environment" and any proper measurement of progress must include an accounting of the environment (Bleys, 2012, p. 365).

2.7.3 Sustainability Measures Within Wellbeing Indices

The relationship between wellbeing, the environment and sustainability suggests the complexity of developing adequate indicators that can be used to measure or predict this relationship. According to the 1987 Brundtland Report (produced by the World Commission on the Environment and Development), our intentions should be to maintain the system that is human life (social, environmental and economic) in a manner that preserves these three realms for the next generations to come. According to Bleys (2012 "... there must be no single object of sustainability, but instead all of the economic, social and environmental systems must be simultaneously sustainable in and of themselves" (p. 365). The HDI and OECD Better Life Index are useful in that they provide an initial step in analyzing sustainability and they create a distinction between weak and strong sustainability. The OECD index differs from other wellbeing indices in that it aims to capture well-being achievements rather than losses and suggests that sustainability indicators should be measured on a stock and flow basis. It also suggests that there needs to be a noted difference between indicators that measure foundational wellbeing and those that are directly amenable to monetary evaluation (Stiglitz, Sen, & Fitoussi, 2010). Environmental indicators predominantly use homogeneous units to measure certain social characteristics, typically in monetary amounts (Gadrey & Jany-Catrice, 2006). There are many ways to incorporate environmental indicators into wellbeing indices but two are commonly used. The first is to use a weighted average of heterogeneous variables and the second is to use the monetization of certain variables to show how the environment can be incorporated into a predominantly economic measurement.

Hicks (1946) acknowledged that the purpose for calculating income is to indicate the maximum amount of people that can produce and consume without going over their carrying capacity in order for them to produce and consume in the future. Adjusted GDP indices resemble current economic indices and subtract total private consumption that does not contribute to positive

welfare to produce economic welfare. The Genuine Progress Indicator (GPI) measures consumption with the same data used in the GDP, however degredations in natural and social capital and the value added by the informal economy (volunteering and household work) are included in producing "sustainable economic welfare" (Talberth & Cobb, 2006). According to Talberth & Cobb (2006) "This framework contains normative guidance to promote long term eeconomic development that increases the benefits from a given stock of resources…" (p. 5). The Canadian Environmental Sustainability Indicators Program (CESI) was developed to record information on Canada's environmental sustainability performance using a similar framework to the Genuine Progress Indicator. It focuses on issues of climate change, air quality, water quality and availability of resources and uses data from Environment Canada, Health Canada and Statistics Canada (Environment Canada, 2015). Indicator results are linked to key social and economic drivers and information is provided on how the issues are influenced by consumers, businesses and governments (Environment Canada, 2015). Because sustainability incorporates the ideas of quality of life and management of expectation, describing it only quantitatively is unrealistic. Indicators are by nature quantitative; however qualitative analysis is important for understanding how to use them effectively.

> *A true measure of sustainability requires a dW index where assets are valued not at market prices, but rather using imputed "accounting prices" based on some objective physical or economic modeling of how future damage to the environment will affect well-being, just as it requires an exact evaluation of how current additions to the stock of human or physical capital are likely to improve or help maintain well-being in the future. (Stiglitz, Sen, & Fitoussi, 2010, p. 120)*

2.8 The Environment Domain of the CIW

In 2012 the CIW reported that of the 8 domains identified as being important to Canadians two (Education and Living Standard) were increasing at the same rate as GDP but the 6 other domains (Community Vitality, Health, Democratic Engagement, Leisure and Culture, the Environment and Time Use) were lagging behind, with the Environment domain suffering the most.

Trends in the Canadian Index of Wellbeing with Eight Domains and Compared with GDP, 1994-2010
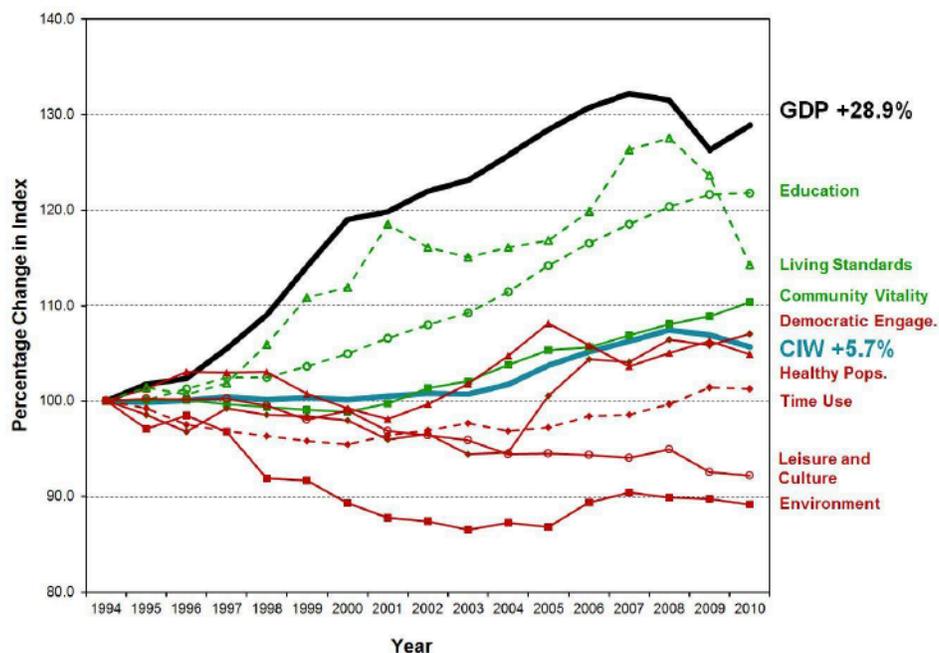
The CIW takes an anthropocentric perspective in the environmental domain and focuses on resources that play an important role in the economy. Sustainability is considered a core value that drives the work of the CIW. However incorporating sustainability into the index remains problematic (Michalos et al., 2011, p. 63). A stock-based approach to sustainability focuses on what resources the current generation can pass on to the next and how well humans can maintain the quantity and quality of all the other renewable natural resources that are necessary for life (Stiglitz, Sen, & Fitoussi, 2010). The CIW Environment Domain Report says the environment domain uses eight existing natural capital based stock and flow indicators: Ground Level Ozone, Absolute GHG Emissions, Marine Trophic Index, Primary Energy Production, Canadian Living Planet Index, Water Yield, Ecological Footprint and Viable Metal Reserves Index (Morgan, 2011). A description of each is included in the report by Alexis Morgan. Wilson and Tyedmers (2013) argue that because measures of wellbeing and quality of life are often a collection of indicators organized around domains, a challenge then occurs when deciphering between a group of indicators, which are loosely organized around a specific project or goal. One of the goals of the Canadian Index of Wellbeing was to efficiently balance the number of indicators and domains.

Such a snapshot cannot capture the full picture of Canada's environment, nor a full description of whether our use of the environment is "sustainable" or not. However, it does provide clear trends related to our collective natural capital, and in turn, Canada's wellbeing. (Morgan, 2011, CIW Environment Report, p.iii).

According to Morgan, there were some obvious limitations restricting the success of the environment domain with measuring what it set out to measure. The overall complexity of the domain compared to the seven others in the CIW, the data limitations and national limitations with a domain that spreads across regional and provincial boundaries were mentioned at the very beginning of the report (Morgan, 2011).

2.9 Regional Sustainable Development

Sustainable development strategies must recognize the interconnectedness of economic, social and environmental indicators. In the 1980s, Hancock created the 'Mandela of Health' that describes the links between health and environmental and economic wellbeing (Hancock, 1993). The Mandela of Health is based on the understanding that human culture is inexplicably linked to the natural environment. Culture and the biosphere affect every aspect of human life (Hancock, 1993). The model was developed to address issues in public health, a top priority in developed countries and focused on two public health principles, equity and sustainability and applied them at the community level (Hancock, 1993). The Mandela views health as being a holistic system and highlights the importance of natural ecosystems in public health at the community level. It expands from individuals, families and communities to the developed environment and is encompassed by culture and the biosphere (Hancock, 1993). The model is dynamic in that it can change shape and size according to its importance and value in different communities (Hancock, 1993). Hancock also uses the word 'sustainability' in the sense of sustaining all life, not just human life (1993). Equity is used to describe the right every human has to the satisfaction of basic needs and the opportunity to achieve health (Hancock, 1993). Although Hancock's model was not intended to be used as a predictive tool, by demonstrating important interrelationships in maintaining public health, the model can be used for strategic purposes in community development (Hancock, 1993).

The success of wellbeing indices is based on the quantity as well as quality of data gathered. Those that are considered unsuccessful are those that do not have access to valid or sufficient data.

The developers of indices often take the theory and practice approach, developing indicators around what can be applied to a specific group of people. There is now considerable awareness of the abundance of environmental indicators and continuous development of these indicators and monitoring strategies; however, this onslaught of information can be more confusing than helpful. In 1998, the 'DRIP' (Data-rich, information-poor) phenomenon was identified. It often occurs when indices attempt to capture all details of human activity, without acknowledging the larger system (Hoernig & Seasons, 2004). According to Hoernig and Seasons (2004) indicators in regional planning practices require a holistic approach and in order to avoid the 'DRIP' planners must be aware of what a specific monitoring indicator will be used for and define a set of specified, prioritized purposes that relate directly to what they want to monitor. This cannot always happen when dealing with complex terms such as wellbeing and sustainability.

2.9.1 Healthy Cities

The expansion of holistic perspectives has helped to develop more of what planners call "integrative approaches" to indicator use (Hoernig & Seasons, 2004). The three most commonly used holistic terms are sustainability, quality of life and healthy cities (Hoernig & Seasons, 2004). The holistic term "healthy cities" evolved from the "New Public Health" in the early 1990s when socioecological models began to integrate physical and social environmental determinants with human health (Hoernig & Seasons, 2004). Just like healthy cities, quality-of-life measurement uses a holistic approach to assess individual wellbeing (Hoernig & Seasons, 2004). Measuring quality-of-life is much simpler because it pulls from existing data and recognizes the criteria that need to be monitored. Quality of life indicators group together a number of available indicators across a wide range of social, economic and environmental sectors. There is a need to understand and clarify the linkages between sustainability, quality of life and healthy cities indicators. Indicators should also have target points, so that it is clear whether or not a target has been reached or breached or if a critical threshold has been eluded (Hoernig & Seasons, 2004). Indicators should also be able to identify critical features of populations across geographical areas and be able to distinguish local and non-local sources of environmental effects (Hoernig & Seasons, 2004). The inclusion of healthy cities and quality-of-life measurement approaches provide a more well rounded set of criteria and illustrate the extremely complex relationship between the natural

environment and human well-being. Hoernig and Seasons acknowledge that what sustainability indicators lack is the ability to explain power, and identify causal factors like agents, mechanisms and processes of change (2004).

2.9.2 Community Development

The term "smart growth" was created from the overwhelming pressure on planners to fix infrastructure problems with environmentally savvy alternatives. Canadian infrastructure issues became connected with environmental planning in the last decade of the century because of issues in declining air quality and increases in road congestion (Hodge & Gordon, 2008). Smart Growth is politically appealing and focuses on Brownfield development, new urbanism and transit-oriented development with the addition of ecosystem planning (Hodge & Gordon, 2008). The idea of "Smart Growth" changed the way communities were looking at development, which was becoming more strategic and holistic. The push for overall healthier communities came while Smart Growth was its most popular and public health issues were a priority for community planning (Hodge & Gordon, 2008). The unidentified goal of planners was to create healthy communities by connecting city design and public health and this is where concern over the environment was identified as a major issue (Hodge & Gordon, 2008).

2.9.3 Community Sustainability Indicators

Hodge and Gordon (2008) claim that the 1990 sustainable development movement, brought on by the 1987 Brundtland Report was the beginning of the merging of environmental planning, social planning and economic development. Sustainable Development became a guiding principle for planners who began to examine how sustainability could be incorporated into their community plans (Hodge & Gordon, 2008). According to Hodge and Gordon regional planning is important in two different situations. Rural and non-metropolitan regions of Canada focus on maintaining settlement systems, rejuvenating economies and conserving resources and the large urban metropolitan regions strive for efficient and direct urban growth (Hodge & Gordon, 2008). According to Joan Martinez-Alier (2002) environmental problems are pushed to higher spatial scales and longer temporal scales because global cities that are densely populated cannot produce anything of commensurable or comparable value in return for the energy they import and

emissions they produce. Environmental problems are not measured in the area in which they originate, making them difficult to address. The development and application of specific environmental indicators are more likely to be critical to policy development in rural non-metropolitan areas, although this does not preclude their use in large urban regions because often there is overlap between the two. Environmental conservation fits well within a planning agenda in which three streams have been identified: 1) planning aimed at rural resource development conservation and the environment, 2) planning aimed at maintaining and protecting rural regions and 3) planning for rejuvenating rural economies (Hodge & Gordon, 2008).

Ecological planning and environmental planning have evolved substantially over time and the resources and indicators that have been developed have also evolved. During the 1930's ecological planning was focused on projects involving the river basins in Ontario, soil and water conservation in the Prairie regions and saltwater intrusion in the Maritimes (Hodge & Gordon, 2008). Urban environmental concerns became more important to Canadian planners in the 1970s when Rachel Carson's *Silent Spring* (1962) warned of the consequences of pesticide use and other chemical pollutants from the rising number of urban projects; and the term environmental planning was created (Hodge & Gordon, 2008). Large scale urban planning projects demanded the development of Environmental Impact Assessments. According to Hodge and Gordon (2008) environmental planning has improved steadily in the last two decades, moving from rural communities to large scale metropolitan areas, however it continues to remain excluded from economic development and social planning and focuses on the small remaining green space in urban settings and how to conserve it. According to Hodge and Gordon(2008) good planning practice now protects environmentally sensitive areas such as wetlands, connects parks and river valleys with greenways and incorporates storm-water ponds into neighborhood open space.

According to Hoernig & Seasons (2004) regional and local planners take a community wide perspective in their efforts to coordinate the various dimensions of social and economic life within the physical environment. Current planning practices monitor the strategies used for tracking indicators because of the complexity of the issues being examined (Hoernig & Seasons, 2004). The variety of indicator types that have been developed by organizations and government agencies over the past decade has been both helpful and challenging to planners; however there is

little literature that elaborates on the development of comprehensive monitoring strategies using these indicator methods (Hoernig & Seasons, 2004).

The four environmental monitoring concepts forming the basis for small-scale planning (municipal, regional) are adaptive management, environmental impact assessment (EIA), the pressure-state-response (PSR) model and state-of-the-environment reporting (Hoernig & Seasons, 2004). These approaches are seen as classic environmental monitoring practices. It is often more important to develop a strong monitoring strategy and then identify the indicators that fit best within a conceptual framework. Planners identify indicators as "a set of rules for gathering and organizing data so they can be assigned meaning" (Hoernig & Seasons, 2004). They are seen as part of a larger monitoring strategy that is apparent at the beginning stages of a project. However, monitoring of the indicators chosen is a long, resource-intensive process that requires accessible information exchange (Hoernig & Seasons, 2004). Accessible community information is important for social indicators addressing social problems such as poverty and safety, however Hammond et al., (1996) explains that an environmental indicator system has yet to be comparable to those economic and social strategies.

2.9.4 Community Wellbeing Indicators

Cox, Frere, West & Wiseman (2010), offer two perspectives on community indicators that suggests they can be used to support evidence based policy making, or they can be used as a tool for democratic decision making and the growth of citizen engagement (Cox et al., 2010). While wellbeing indicators are often seen as statistical data sets used for understanding the stock and flow of community life, they can also be seen as a representation of competing values and priorities.

Consideration of the significance of community indicators therefore needs to extend beyond simplistic distinctions between top down and bottom up approaches to explore the ways in which new reciprocal partnerships and dialogues are being formed between citizens, community organizations, elected representatives, policy makers and statistical experts (Cox et al., 2010 p.2).

An example of a local indicator program which acknowledges community wellbeing indicators in order to support community planning and reporting is Community Indicators Victoria (CIV) in Australia. According to Cox, Frere, West and Wiseman (2010) the CIV delivers local

government level reports on wellbeing and sustainability trends as well as providing a focus for improving government and community capacity to develop and use community indicators. The local government in Victoria addressed 'community wellbeing' in a way that identifies the most important aspects of social, environmental, cultural and governance goals of the community and recognizes that each community has a different set of priorities (Cox et al., 2010). Although the importance of developing prioritized indicators for each area is recognized, the model used for the development of the indicators can be used on different local, regional and national scales and a wide range of theoretical assumptions and perspectives are included (Cox et al., 2010). The idea here is not to create a single definition for wellbeing, but to create a universal framework for how to measure how each community defines wellbeing. In this case, wellbeing indicators are used as statistical tools for translating broad community goals into clear tangible and commonly understood outcomes and for assessing and communicating progress in achieving these goals (Cox et al., 2010).

From the literature it can be determined the GDP is an inadequate measure of human wellbeing. Several international and national level wellbeing indices have been developed in response to the "Beyond GDP Movement" including the Canadian Index of Wellbeing however none appear to be entirely successful at exploring, integrating and/or measuring wellbeing, the environment and sustainability. Indicator development is a complex but important process and the role of the environment in indices of wellbeing is not yet fully realized despite the amount of research devoted to exploring how important the environment is to encouraging and maintaining human wellbeing. Policy development in the areas of wellbeing, the environment and sustainability to focus on the regional or local rather than the international or national level and developing adequate measures of wellbeing, the environment and sustainability that can be useful at this level remains problematic.

Chapter 3 Methods

Extensive research has been conducted on the relationship between wellbeing and the environment. The role that the environment plays in the progress of human wellbeing is undeniable but the role that it plays in the operationalization of wellbeing and the development of indices used to measure it is more difficult to determine. It is possible that the environment and wellbeing relationship can be clarified and more effectively expressed in an index of wellbeing than it is currently. This could result in better efforts to address sustainability issues in policy development at both the national and regional levels.

The first objective of this study was to gain a relevant and useful understanding of the way in which wellbeing indices are developed and make recommendations for the Canadian Index of Wellbeing to enhance how the environment is conceptualized in the index. A review of various well-known wellbeing indices was carried out to gain a better understanding of how wellbeing is measured and how the natural environment is conceptualized in current wellbeing indices. The literature provided an understanding of the history behind the development of wellbeing indices in light of the beyond GDP movement. It provided insight into the ambiguity of complex terms such as progress, wellbeing, and sustainability and the difficulties inherent in developing adequate and useful measures of these concepts. This study used a qualitative approach to explore and understand the meaning of wellbeing, how it can be measured and how this measurement is applied using the Canadian Index of Wellbeing.

Research Question: How can the Environment Domain of the Canadian Index of Wellbeing contribute to an understanding of wellbeing and communicate strategies that promote strategic sustainable development?

The first stage of this thesis was to gain an understanding of how wellbeing indices measure the environment in regards to its relationship to human wellbeing. This was done by interviewing key informants: developers, researchers and experienced professionals in the wellbeing/quality of life field. The second part of this study involved using the information collected from the interviews to explore how the Environment Domain could be further developed by analyzing it

from the perspective of the DPSIR and Material Flows Analysis perspective in order to provide recommendations for the CIW.

3.1 Design

Qualitative research is an interpretative research paradigm that assumes that there are multiple meanings and realities that are all valid when it comes to dealing with complex problems. Its purpose is to discover what those meanings and realities are. Constructivism often employs qualitative methods because individuals construct meaning about their experiences and when they share this information it helps others gain an understanding of how they view the world. Qualitative data emphasizes the value of understanding different ways of knowing and it values insider knowledge. Dominant paradigms are shaped by cultural background and by the context of the historical moment. Current paradigms within the social sciences emphasize the worldview or the set of experiences, beliefs and values that affect the way an individual perceives reality and responds to that perception; thus qualitative data can be described as subjective rather than objective. The analysis of qualitative data employs descriptive and interpretive techniques and seeks to explore rather than explain. Although quantitative questionnaire and survey methods are useful and allow for a broader more representative sample of participants, measuring the relationship between wellbeing and the environment is complex and it was hoped that by using a qualitative design, semi structured interviews and a largely inductive approach would help illustrate some of the nuances of this complexity. This study focuses on extremely complex terms (progress, wellbeing and sustainability) that are often used interchangeably depending on how individuals perceive them. How we come to understand the nature of wellbeing and the role that the environment plays in enhancing it may depend on how people understand not only those terms but as well the importance of those terms and how they are related one to the other.

3.2 Selection of Participants

Given the complex nature of the study's topic, it was decided to interview key informants in the development and application of wellbeing indices and planners whose job it was to apply information about the environment within their local communities. Snowball sampling was used

to recruit participants for the study. By selecting a primary group of participants and asking them who they would recommend for participation in the study the snowball gets bigger and bigger and the number of key informants grows. According to Marshall (1996) key informants are able to provide more information and deeper insight into a problem because of their personal skills or position and usually but not always occupy a position of responsibility and influence. Key informants can help develop a definition of the dimensions involved in the problem; they can help discover boundaries surrounding the problem and they can identify extremes or outliers. Key informants can also identify other potential key informants so that recruitment of participants continued even as interviewing got under way.

The preliminary selection of informants was based on identifying individuals who occupied a formal role in the development or application of a well-known wellbeing index that contained a strong environmental domain. Original participants were selected based on their professional and academic history. Other key informants were selected based on their background in regional planning in order to gain an understanding of the relevance and applicability of the Canadian Index of Wellbeing from a local policy making perspective. According to Marshall (1996), it is important to select informants with a wide range of views. During the initial stages of developing this research, I had hoped to interview key informants who had been involved in the development of the Human Development Index, the OECD Better Life Index, the Gross National Happiness Index and the Genuine Progress Index as well as the Canadian Index of Wellbeing. However, it took longer than expected to recruit participants, arrange interview times and conduct the interviews. It took some time to find informants who possessed specialized information on the topic of the development of wellbeing indices and who could be identified by formal or informal role in that development. Although different interpretations and realities are valued, the participants needed to have access to the kind of information that would allow them to provide informed interpretations. An open-minded approach to the data collected was needed in order to view it from the perspective of the participants. Deviation from the preliminary design was also needed due to the discovery of overlapping roles or lack of knowledge; the discovery of individuals who fulfilled some of the criteria but did not occupy formal roles; personality factors and/or operational inconvenience.

I started out approaching people who had worked directly on the Canadian Index of Wellbeing. The development of the index was a long-term project in which a number of academics

and professionals were involved in different aspects of the index at different times. There were several key players involved in the project from beginning to end and others who were only involved in specific areas like the environment domain. Snowball sampling was used to recruit participants and involved my approaching people I knew who would be interested and asking them to recommend others they knew who might be interested in participating. Through snowball interviews and connections with the CIW, I was able to choose key informants based on their experiences with indices. After a number of key informants were selected, they were invited to participate by email. I obtained the email information from public websites and the CIW directory. After a key informant agreed to participate in the study, a second email was sent to arrange a convenient time and place for a meeting.

Participants were given a brief description of the study, its purpose, along with my contact information, contact information for my supervisor and the University Ethics Office. Each participant was provided with a description of the study and an explanation of how the findings would be used. Informants were assured confidentiality, and informed of their right to terminate at any time or leave any question unanswered. They were also asked to sign a consent form acknowledging that they were willing participants in the study. Qualitative interviews are not anonymous and although all interviewees were advised that their interviews would be kept confidential all participants agreed to be identified. I answered any questions that the participants had about the study and because there were no anticipated risks to their psychological or physical health, no monitoring of the interviewees was required. I informed the participants that the duration of the interviews was to be approximately 1 hour, but many were interviewed based on the amount of time they could give me ranging from 30 - 90 minutes.

The disadvantages of using qualitative interviews for my data collection were mainly related to recruitment. Although I had hoped to interview at least 10 key informants, I was only able to complete eight interviews. The eight interviews however seemed sufficient given the richness of the data collected, the participants' role, knowledge and ability to provide relevant information, my resources and their time. Primary interviews were conducted with Pierre Fillion a Planning Professor at the University of Waterloo who has sat on several provincial government panels and committees in the Region of Waterloo; his research focuses on transportation, land use, suburbs and infrastructure. Pierre Filion suggested I interview Kevin Eby who was at that time,

the Director of Community Planning in the Region of Waterloo. Alex Michalos was the second Director of Research at the CIW. He managed the peer review process for the final eight domain reports and developed the methodology for the CIW and is still involved with the CIW through the Canadian Research Advisory Group. During my interview with Michalos he recommended I interview Alexis Morgan who was a consulting stakeholder for the environment domain of the CIW, and wrote the 2011 Environment Domain Report.

The Canadian Index of Wellbeing recommended I speak with Mike Salvaris, John Talberth, Mark Anielski and John De Graaf who are all involved with independent wellbeing research and have provided valuable input into the CIW. Mike Salvaris is the director of the Australian National Development Index (ANDI), who has worked on projects such as "Measures of Australia's Progress" and "Community Indicators Victoria". He has also been a long-term participant and advisor in the OECD Global Project and has done research with the CIW. John Talberth works primarily with the Genuine Progress Indicator. He is the president and senior economist at the Center for Sustainable Economy and participated in the development of the Ecological Footprint. Mark Anielski is the author of "The Economics of Happiness", has a background in accounting and economics and began working with the Genuine Progress Indicator in 1995. He is considered an expert in measuring the sustainable wellbeing of communities, having developed the Genuine Wealth Model and he is the Chief Wellbeing Officer, Director and Co-founder of the Genuine Wealth Institute. John De Graaf is an author, filmmaker and Executive Director of "Take Back Your Time". He has produced 15 documentaries and is the Co-founder of the "The Happiness Initiative". He was also an advisor to the government of Bhutan and participated in the development of the Gross National Happiness Index.

I identified five other key informants; however, they were unable to provide interviews. The Happy Planet Index key researchers were on maternity leave. I did not receive a response from the OECD or the Human Development Index after several email attempts. A key informant who had been involved with the CIW and is currently involved with the Gross National Happiness Index could not find time to participate. One contact presented by my research advisor Simron Singh suggested two possible participants; one was interviewed (John De Graaf) and the other was unable to confirm an interview date and time.

3.3 Qualitative Design

Qualitative researchers can use various forms of data collection methods. The two I chose were key informant interviews and document collection and examination. In depth semi structured interviews with key informants was the chosen method for the first stage of data collection. The participatory "conversational" approach described by Bell and Morse (2001) was used to collect the perceptions, ideas and assumptions about wellbeing and environmental sustainability that are revealed by those involved in the development or application of wellbeing indices. This approach examines wellbeing and sustainability through a social science perspective that includes anthropology and social activism. The interviews are semi structured in the sense that a framework was initially developed to provide the interviewer with a focus for asking questions. Although the framework includes questions that are predetermined, the interviewer is free to ask new questions that may evolve as the interview progresses. The framework allows for questions to be reworded, asked out of order or to be skipped entirely depending on the direction that the interview takes. Semi structured interviewing allows both the interviewee and interviewer flexibility so that the topic can be covered in the most thorough way possible. By maximizing flexibility, it is hoped that rich and descriptive data will be more likely to emerge. Skilled interviewers are able to shape conversations with participants so that the most interesting, thought provoking and relevant data is the type of data that emerges. Good questions that help to keep conversations going also tend to be open ended. According to Patton (2015) open ended questions enable researchers to understand and capture the points of view of other people without predetermining those points of view (p.21). During the course of the research, it was expected that I would have to change some of the questions, drop some and add others depending on the type of data that was emerging from the interviews.

Two questionnaires were originally developed, one for those involved in the development of wellbeing indices and one for regional planners in the Region of Waterloo. A set of 10 questions was developed to provide an initial framework for the interviews however, as participants began to share information, some of the questions within the framework changed. Informants were given wide latitude to choose content as well as order and manner of presentation. In many instances, I was required to re-word or change some interview questions depending on how the participant was

answering the previous questions and some questions in the original questionnaires were asked out of order or missed entirely, while new questions were added to explore new information. The design unfolded or emerged as data was gathered.

The task of an interviewer in semi-structured interviews is not to stick to a predetermined set of questions but to listen actively. A potential liability in any interviewing situation is the researchers' lack of listening skills. Active listening is listening for what matters, listening for deep understanding and listening for meaning. This is how insight and new knowledge develop. To address the danger of not listening actively, I conducted only one interview a day. All participants were able to choose when, where and how they wanted to be interviewed, in person, through Skype, or over the telephone and all interviews were conducted between September and December 2014. The date and time of the interview was dependent on the informants' schedule and took place in a number of settings. Two in-person interviews were conducted at the offices of the participants; Pierre Fillion's interview occurred at the University of Waterloo in the Planning Department and Kevin Eby's interview occurred at his office in the Region of Waterloo building. Skype interviews were conducted with Alexis Morgan in Edmonton Alberta, John Talberth in Oregon, USA and Mike Salvaris in Australia and Alex Michalos and John De Graaf's occurred over the phone. Mark Anielski's interview occurred over the phone while he was driving. I was in my home office during the Skype and telephone interviews. With participant consent, each interview was audio taped with two devices (recorder & iphone).

In order to get participants talking I began each interview by asking them about their background in the organization with which they were involved. Then general questions about what they believed about wellbeing and what they understood the concept of wellbeing to be were asked. Then specific questions about the CIW were asked, limitations and boundaries were discussed and then recommendations, ideas and beliefs about the future of wellbeing indices finished the interviews. The open-ended nature of the questions and the flexibility of their order meant that interviewees could speak freely and when unexpected but relevant topics emerged, these could be pursued. This meant that the questionnaires evolved over time. This also meant that not all informants were asked the same questions. Time, knowledge and interest were factors in the inclusion or exclusion of some of the questions and their order of presentation. Each set of interview questions was modified according to the role played by each key informant in the

development of indices of wellbeing and the organizations with which they were affiliated. The interview protocols that were developed followed a format similar to the following based on themes explored in the wellbeing literature.

General Questions (Modified for Participants)

1) What is your background?
2) How did you become involved in wellbeing research/wellbeing indices?
3) Are you familiar with the Canadian Index of Wellbeing?
4) How does your index measure the environment compared to the CIW?
5) What is the biggest obstacle when measuring wellbeing?
6) What are you hoping to achieve by measuring wellbeing?
7) Does the index use a anthropocentric approach?
8) Is an adaptable framework important?
9) If you could measure anything regardless of available statistics, what would it be?
10) Will wellbeing indices ever have political influence? Is this important?

The complex nature of developing large-scale indices like the CIW means that without being directly involved in the development process it is difficult to fully understand specific obstacles and challenges in order to make recommendations for the environment domain. Participants that worked directly on the development of the CIW, Alex Michalos and Alexis Morgan, were asked questions more specific to the CIW (Appendix F). The two regional planners, Pierre Filion and Kevin Eby were asked the same questions (Appendix G). Participants who were involved in other indices such as the GPI were asked more comparative questions and explanatory questions pertaining to the index with which they were involved (Appendices H, I & J). If the informant's conversation was irrelevant to the topic or veered repeatedly from the main focus of the interview, I attempted to bring the conversation back but without forcing a predetermined pattern. This technique was self-developing and I was able to refine the interviewing method during the course of a session as the amount of knowledge about the problem was revealed, as I became more confident in the process and as the ability and willingness of the informants to reveal knowledge was drawn out.

3.4 Data Analysis

Qualitative research is descriptive and relies more on interpretation than explanation; thus data must be analyzed inductively. A largely inductive approach was used to analyze the data from the interviews. Data analysis is an ongoing process involving continual reflection about the data, asking analytical questions and writing memos throughout the study. Data was interpreted following a qualitative descriptive methodology, which employs a low inference interpretation and presents facts in everyday language (Sandalowski, 2000, p. 335- 336). According to Sandalowski (2000) "Qualitative description is especially amenable to obtaining straight and largely unadorned (i.e. minimally theorized or otherwise transformed or spun) answers to questions of special relevance to practitioners and policy makers" (p. 337). The data was prepared through verbatim transcription and organization. The transcriptions were then read repeatedly to gain a general sense of concern that emerged from each informant's interview, highlighting comments of interest. Recurring areas of concern were noted in all interviews and data were then coded into chunks or segments and grouped according to potential common areas of concern. Portions were then selected for more detailed analysis. The data was then reviewed for any new perceptions, connections to theories or suggestions for future research. Close attention was paid to word choice and structure and I attempted to identify particular words, sentences or ideas that stood out.

The data were analyzed both individually and collectively. After each interview was completed I transcribed them without using coding software. I allowed time to reflect on the information and highlight comments of interest after the interview was complete. The interviews were transcribed as soon as the interview was completed. While reviewing the transcriptions I looked for emerging areas of concern. I highlighted the words and phrases informants used and grouped similar words and divided different terms into groups and looked for patterns among those using certain terms. Detailed notes were taken during the interview as originally planned; however, I found I was able to participate in the conversation more effectively if I did not take as many notes and focused my attention on what the informant was saying rather than what I was writing.

3.5 Document Analysis

Although my literature review includes key international documents and reports, a more thorough and specific document analysis was conducted after the interviews had been transcribed and analyzed. I wanted to be able to produce specific recommendations for the CIW in terms of the development of the Environment Domain and felt I could not do that with my interview results

alone. This prompted my investigation into secondary sources of data and I examined final reports produced by international and European organizations that were concerned with wellbeing and that had a strong environmental component. I sought out reports and documents that helped me to understand frameworks and models used in similar context to my research. Credibility of the documents was important. It was important to analyze reports designed by international organizations that were considered credible within the environmental and sustainability community. I also explored different approaches to organizing environmental indicator data using a systems approach. I examined reports from the 1987 World Commission on Environment and Development and the 1992 United Nations Conference on Environment and Development. I also examined a number of reports produced by the Organization for Economic Cooperation and Development (OECD), the European Environmental Agency and the European Commission (Eurostat). The intent of which was to see how the Environmental Domain of the CIW could be expanded, enhanced and or developed so that it could become more effective in terms of its ability to communicate relevant and important information to both the general public and policy makers concerned with developing policies designed to enhance wellbeing, protect the environment and improve sustainability.

3.6 Credibility, Authenticity and Trustworthiness

Those who engage in qualitative research have a responsibility to present their data in a way that others find believable. Trustworthiness and authenticity are the goals of qualitative methods. The researcher must present an interpretation of the data that is convincing. This might involve relating information gathered from informants to other sets of data or to theories in the relevant literature. Consideration of and presentation of alternative interpretations of the data can also enhance believability. The results should be dependable and easily confirmed and other researchers must be able to replicate the findings. Dependability is enhanced when the researcher is able to produce an audit trail. This would involve creating a systematic process whereby all steps in collection, analysis and interpretation can be replicated. Documentation of all components of the study including interview notes, observation notes and various drafts of the researcher's interpretations during the timeframe of the study were kept.

Qualitative researchers become involved and establish a specific role within their study, unlike quantitative researchers who often attempt to disassociate themselves as much as possible from the data collection process (Golafshani, 2003). The nature of the relationship between interviewer and interviewee is complex. According to Patton (2015) empathic neutrality is needed in order to understand something without judgment. It requires that both the interviewer and interviewee exhibit awareness, openness, responsiveness, sensitivity and respect. During this study I assumed the role of an interested and curious researcher looking to gain valuable information from key informants using conversational techniques. I was constantly checking that I was aware, open and responsive to what the interviewee had to say. I would restate the interviewee's answers to my questions to make sure that I understood the meaning and I would ask follow up questions to show responsiveness and interest. I was sensitive and respectful at all times during the process. I was aware that the interviewees knew far more about the topic than I did and I considered myself fortunate to be able to discuss this with them. This encouraged more openness and responsiveness on the part of those being interviewed.

The goal of qualitative research is not to look for causality as is the case with quantitative research. The goal is to better understand and explain an otherwise confusing situation (Golafshani, 2003). This study sought to better understand the role that the environment plays in the development of wellbeing indices, specifically the Canadian Index of Wellbeing. Interviews with key informants were conducted to gain access to information otherwise not present in the literature. As the researcher, I acknowledge that the information presented in this study will be continually evolving. The key informants interviewed were chosen because of their knowledge and experience in the field and were identified as credible sources on the topic of wellbeing indices. An examination of trustworthiness in qualitative research is critical. There should be a reasonable explanation for any information provided in the interviews and this is especially true when the richness of the detail goes beyond what was expected from the participant. Trustworthiness, authenticity and conformability of the participants were assessed through an examination of internal consistency and cross comparisons. After each interview, assessments were made about how authentic the interviewee seemed during the process and how trustworthy he appeared to be based on his position, his area of expertise and how other interviewees referred to him. Areas of discrepancy during individual interviews were also noted. Patton (2015) explains it is possible to achieve trustworthiness and authenticity in a qualitative study by using mixed methods, but it can

also be achieved by including multiple perspectives. Although I wasn't able to interview as many key informants as I had originally planned from a wide variety of wellbeing indices, I was able to interview those who possessed unique perspectives based on their personal and professional experiences. Each participant brought something interesting and new to the process and no participant refused to be identified. Although they were offered the opportunity to provide additional feedback they chose not to, although all participants were interested to know about the recommendations that would be made to the CIW and the environment domain. They will be contacted once the thesis is completed.

3.7 Limits and Boundaries

The most important assumptions made in this study were that there is a relationship between wellbeing and the environment, the relationship can be explained and the relationship can be measured. There are obvious methodological limitations to this study given the complex nature of the topic. I did not have much control over the sample size and types of people being interviewed and I was apprehensive that I would not have enough participants. The research was conducted on a limited number of indices and with a limited number of key informants due to the difficulties securing participants from large-scale, well known indices such as the HDI. The sample was unbalanced in terms of gender, all interviewees were men and all were middle aged or older, although I was able to achieve some variability by interviewing participants involved with different indices.

One of the weaknesses of using semi-structured interviews is the fluidity of participant responses. Different researchers, in different settings and under different circumstances may elicit different responses. Another potential weakness identified by Marshall (1996, p. 93) is that key informants may only divulge information that is politically acceptable Participants may exclude details that are embarrassing or exaggerate their role in any endeavor in order to enhance status or esteem. It is common among wellbeing indices that there is a need for improvement and strategic design. Indices are constantly evolving, so timing is important. What was revealed by a key informant in the Fall of 2014 may not be revealed at another time. The study was limited to exploring how people involved in the development of wellbeing indices view and articulate the

relationship between wellbeing and the environment and cannot be generalized to other indices or other influences on wellbeing. Many factors independent of the environment change the human condition and many natural forces influence the environment. However, by improving measures of wellbeing and sustainability, decision-makers can be provided with the information that often defines the success or failure of public policies. "Evidence of such success or failures can be used to reallocate resources, or to replace governments; hence the calculation of measures of well-being is an important issue" (Osberg, 2002, p. 292).

Chapter 4 Interview Results

The purpose of the interviews was to determine how the CIW effectively captures elements of the environment as it relates to Canadian wellbeing. During the course of the interviews, key elements that were used to determine an effective wellbeing index and the obstacles that needed to be addressed during the development process were examined. Two regional planners were interviewed in addition to six index developers to gain an understanding of how indicators could be used at a regional level and how a national index like the CIW could be useful for regional level planning. The interview results were organized to reflect the most important elements involved in the development of wellbeing indices according to developers of those indices, and describe the challenges and obstacles involved in developing a complex domain such as the Environment Domain in the CIW.

Information gathered from the participant interviews appeared to indicate common and recurring elements of concern when it came to the development and use of environmental indicators. These elements of concern included: the intended purpose of wellbeing indices, the type of framework used, the problems of measuring in systems, obstacles to overcome in development and use, scalability, the information derived from the index, the communicativeness of indices and the need for partnerships during the development and implementation of wellbeing indices. These elements of concern were fairly straightforward and simple to understand and could prove useful for members of the general public and/or policy makers who might not fully appreciate the challenges involved in the development of wellbeing indices. The order of these elements roughly follows the order of the interview questions, but is modified slightly by the emphasis placed on the concern by the interviewees, the number of interviewees who identified the concern and how important interviewees thought the concern was.

4.1 Intended Purpose

The intended purpose of a wellbeing index refers to the intentions of the index during the initial stages of development. What creators of any index ultimately want to achieve by measuring the wellbeing of a given population and whether or not they can achieve this are important

considerations in index development. The intended purpose of an index is important to acknowledge at the outset. If an index achieves its intended purpose, it can be considered successful. As reported in 2012, it was hoped and intended that the Canadian Index of Wellbeing would have several purposes. The stated purpose behind developing the index is to discover how Canadian society is doing and discover what Canadians valued the most in terms of personal and cumulative wellbeing. Alex Michalos explained that the intent of the CIW was always to capture an "*overall picture*" (personal communication, September 30, 2014). With such a broad mandate, it was necessary to consult a wide range of individuals, members of the general public as well as professionals working in the field. According to Michalos *"Quality of life is a multi-dimensional kind of thing and in order to capture everything you had to go at it from a variety of viewpoints"* (personal communication, September 30, 2014). Trying to determine and measure everything that Canadians value however presents a unique set of problems especially when it comes to application. Pierre Filion, a planner with the Region of Waterloo described the costs and benefits of taking a general versus specific approach when it comes to defining wellbeing. "*When you become more specific with the way you define wellbeing then you start to introduce biases in the rankings. If you leave it general you can't use it for rankings. There's a problem on both sides"* (personal communication, September 17, 2014).

Because the concept of wellbeing is so intriguing, complex and potentially powerful, it tends to draw the attention of researchers and academics. When it comes to practitioners such as planners who are responsible for using the concept in order to create policies to ensure or increase wellbeing, then wellbeing is less likely to be thought of in abstract terms and more likely to be operationalized as a group of specific activities that can be measured and encouraged in a population. For practitioners, it may be that the only purpose of a general, multidimensional concept of wellbeing is that it can open up discussion about what citizens want in terms of planning for their local communities. According to Pierre Filion,

> *Wellbeing is undefined in the planning world. If you were to ask planners what is wellbeing in the city, they would say easy commute, easily, walkable active cultural life, easy access to green space, good air and water quality. When you have indices like that [CIW] it gives you more of a common base for a discussion of wellbeing" (* personal communication, September 17, 2014).

There appears to some tension between the theoretical or academic approaches to wellbeing and the application of it at a community level, as there inevitably are when attempting to apply multidimensional abstract concepts to problems that exist within local communities. In the words of Pierre Filion *"It [wellbeing] is generally part of the intention pursued but whether it is specifically put into practice is not typical"* (personal communication, September 17 2014). Just because a concept is complex and multidimensional does not mean that its intended purpose needs to be vague. According to Mike Salvaris who worked on the Australian National Development Index (ANDI) definable goals give wellbeing indices value. *"When you define things towards a goal it does give them a certain sharpness"* (personal communication, October 22, 2014*).*

4.2 Framework

The framework of a wellbeing index refers to the criteria for which the domains and indicators are selected and the different types of indicator frameworks have been outlined by Stiglitz, Sen & Fitoussi (2010) discussed in the Literature Review. Different wellbeing indices have been developed for application at different scales in different regions and presumably for different purposes. Composite indices are composed of a number of relevant indicators and the weighting of each domain/indicator shows the value of that indicator and its role in the development of wellbeing. There are several indices that focus only on the environment and sustainability such as Ecological Footprint and in these indices different weights are assigned to specific environmental indicators to produce a more detailed account of the state of the environment at any given time. One of the most frequent criticisms leveled at general wellbeing indices is that they are most often composite indices and in the development of a composite index, important information that could be useful in understanding and addressing environmental sustainability may be obscured. According to Alex Michalos equal weighting was used in the development of the CIW domains. He explains that "*Because there is no generally accepted way of assigning weights to wellbeing indicators the simplest solution was to assign an equal weight to every domain in the CIW. It was just easier to make everything the same"* (personal communication, September 30, 2014*).* This approach is supported by John DeGraaf from "The Happiness Initiative" when he describes the CIW's framework as being a balanced measurement

"I think if you want to measure quality of life and wellbeing you really have to do that (equal weighting)" (personal communication, December 9th, 2014).

Of all the environmental indicators identified in the CIW, green house gas (GHG) emissions stood out. It was one of the few environmental indicators that was included in the development of the province of Ontario provincial report *'How are Ontarians Doing?'* (2014) along with Ground Level Ozone. It is the indicator that is the most consistently monitored by Environment Canada and it is the only indicator that is consistently linked to the health domain. An increase of GHG emissions has been associated with influxes of respiratory diseases in Canadians (Michalos et al., 2011). According to Pierre Filion, planners often account for GHG emissions as one of the most important environmental indicators of which to be mindful. *"GHG emissions is a major one and I mean if there is weighting being given to each of them that should be the main one"* (personal communication, September 17, 2014).

There is a question as to whether or not wellbeing indices could be weighted using a non-utilitarian approach. Is it important or even possible to examine elements of environment without taking into account the effect on humans? Is environmental capital only to be considered through the perspective of potential human use? According the author of the CIW Environment Report Alexis Morgan *"Everything was being valued from what nature provides to humans, but the decision was made and that's how we framed it"* (personal communication, October 29, 2014). Mike Salvaris, the Director of ANDI, explains that when constructing a wellbeing index the environment will always be viewed from a bias of human necessity. *"If we in current generations have maximized our wellbeing by consuming the environment in ways that are destructive to future generations that reasoning creates the best bridge to de-anthropomorphize to some extent"* (personal communication, October 22, 2014).

Another popular index of wellbeing that is part of the "Beyond GDP Movement" is the Genuine Progress Indicator (GPI). Considered to be an "*adjusted GDP*" the Genuine Progress Indicator's framework works somewhat differently than the CIW. It assesses the economic value of non-market social and environmental assets that are not generally valued in traditional GDP measurement and assigns a monetary value to things like housework and mature forests. According to Alexis Morgan *"The GPI takes a very neoclassical approach by introducing concepts like environmental economics into the mix and the wellbeing space acknowledges that economics is a*

subcomponent of a broader system" (personal communication, October 29, 2014*). The president and senior economist at the Center for Sustainable Economy, John Talberth explains that *"The GPI is supposed to be a measurement of not only the benefits from consumption but the cost of that consumption so everything is monetized"* (personal communication, October 27th, 2014). Monetization creates a more functional and adaptable index similar to the GDP and according to Talberth *"It's supposed to be related to policy analysis so when we have a piece of legislation like the climate action plan, it's supposed to give us a measurement of cost for those policy changes based on monetary values"* (personal communication, October 27, 2014**).**

Many different frameworks can be applied to wellbeing indices. The effectiveness of these frameworks is based on the intended purpose of the index and sources of data that are available for a given population. Adaptable frameworks allow for smaller scalability and this allows for measurement and comparability among various regions. There are obstacles that are preventing the CIW's framework from becoming more effective. The most important appears to be the lack of good data. According to Morgan *"Environment Canada has been gutted and their indicator sections and the data they have been gathering has been reduced significantly over the past 20 years"* (personal communication, October 29, 2014). According to Michalos there is a solution to the problems with the CIW framework, however the solution is difficult, time consuming and costly *"You can't possibly assign different weights that make sense unless you've done all that science and no one has begun to do all that science"* (personal communication, September 30, 2014*).*

4.3 Measuring in Systems

Systems' thinking refers to the process of how things work. Often used in ecological economics research, systems thinking is a holistic approach to analysis that focuses on the way that different parts of a system like the environment interrelate and how it works over time within the context of a larger system like wellbeing. When measuring a complex idea such as wellbeing, systems thinking is often used because of its ability to show movement (inputs and outputs) and to show relationships between two components. The benefits to measuring wellbeing using a systems approach seems obvious, because of the complex inputs and outputs related to the natural

environment and human wellbeing. All participants agreed that systems thinking is an excellent solution to understanding the complexities with measuring wellbeing, however articulating it into an index like the CIW is easier said than done. Alexis Morgan discusses the obstacles of using systems thinking for the environmental domain in the CIW.

> *The problem with that [stocks and flow model] is that you actually have to look at it from a trained balanced input and output model on a broad global economics perspective. It's the same thing that the FAO (Food & Agriculture Organization) does with food data; it's a giant table that says that the foods coming are coming from here and there and you have to do the same thing if you want to account for the whole environment* (personal communication, October 29, 2014).

He explained that Timber accounts were originally a part of the CIW environment domain, but were ultimately taken out.

> *Between all the trade elements of stocks and flows coming in and out as well as the lack of data for most of this stuff, it is incredibly difficult to build that approach. In many ways, the environment domain intended to have stocks to relate to the state of nature and flows which is human activity affecting those stocks. To delete or add to that, and then the third part that came out in some case studies but needs further focus is on how that then manifests. Why do people value it?* (personal communication, October 29, 2014).

Alex Michalos explained during his interview that of all the domains in the Canadian Index of Wellbeing, the environment domain was the most complex and difficult to develop. "*It was the most difficult to work with because we couldn't find people who could talk to all the various features of the environment*" (personal communication, September 30, 2014). The inability to incorporate stocks and flows was just one of the many obstacles encountered in the development of the domain. Although it is difficult to reiterate a complex system in a simplified schematic, it is not impossible given the use of stock and flow measurements amongst environmental indicators.

4.4 Obstacles and Challenges

In order to establish credibility, it is important to address the obstacles and challenges encountered before, during and after the development of a wellbeing index. The literature suggests wellbeing indices have yet to be taken seriously amongst politicians of developed countries because of suspicions about their credibility. Acknowledging and attempting to address specific

obstacles and challenges would allow decision makers to more accurately assess the credibility of wellbeing indices like the CIW based on information and resources that are available.

In Canada, the environment domain, although weighted equally against all other domains in the CIW is unique because of the way data is collected and this presents an obstacle to creating a domain that is fully accurate, functional and useful. According to Alex Michalos "*The way they collect data from the environment is different from the way they collect statistics for people. Environment Canada has significantly reduced their indicator sections and data collecting over the past 20 years*" (personal communication, September 30, 2014). One of the biggest obstacles in the development of the environment domain has been obtaining good sources of data. There are debates over the type of data that is needed and collected and there are problems with being able to access the information even when it is considered valid and reliable. In order to determine the effects on the environment by human activity, the data collection process must also be consistent over time and with cutbacks at Environment Canada, this is clearly not possible. Aside from the problem of being able to collect good quality data about the environment and find a way to access that data and incorporate it into the CIW, the environment domain is also unique because it crosses boundaries and this has an impact on the type of data that can be collected.

According to Morgan, "*The environment domain bleeds across boundaries more than things like our health care system*" (personal communication, October 29, 2014). The environment domain does not speak to geographic areas outside the physical boundaries of Canada that effect the environment within Canada, such as our consumption patterns that depend on importing and exporting. Morgan brought up this problem when he discussed his disappointment when the food system was dropped as a possible indicator in the environment domain of the CIW. "*I think it was a disservice that it was dropped because the concept that metric embodies is flows of materials going in and out and that's important*" (personal communication, October 29, 2014). Morgan also discussed the fact that the consumption levels of other goods and services which have an impact on environmental sustainability were left out of the environment domain. "*The CIW was designed to tell us how Canada, geographically, was doing but it doesn't speak to our consumption impacts outside our country landscape*" (personal communication, October 29, 2014).

Another obstacle the CIW had when developing the environment domain was gaining access to a range of environmental values. According to Alex Michalos, "*We couldn't find people*

who could talk to all the various features of the environment. The natural sciences were very narrow" (personal communication, September 30, 2014*).* Alexis Morgan and Mark Anielski were specifically brought into the development of the environment domain in order to provide a broader perspective to the role played by the environment in wellbeing. Specifically the developers wanted to go beyond the natural sciences, which have always been the dominant way the environment has been approached in the past, to include the social sciences. According to Alex Michalos, *"The environmental statistics for the CIW came from Environment Canada, a predominantly natural science based collection. The difficulty we had was the environment stats and connecting it to human beings"* (personal communication, September 30, 2014).

When writing the final environment report, Alexis Morgan wanted to show the obvious limitations of the environment domain while giving attention to the important information they were able to gather. *"I wanted to flag the limitations for this domain and to speak to the fact that data really needs to be brought into some of these pieces if we want a consecutive environment domain going forward"* (personal communication, October 29, 2014). He, as well as other developers of the CIW, describe the purpose of the index as providing an overall snapshot, although it continues to struggle with measuring the environment well. It was clear from the interviews with Alex Michalos and Alexis Morgan that the problems encountered with development of the environment domain can be attributed to the problems involved with collecting good data about the Canadian environment. According to Alexis Morgan, *"It is primarily a data collection issue, partially a secondary data compilation evaluation piece"* (personal communication, October 29, 2014). According to Alex Michalos *"The domain is for sure a work in progress because you have various measures like the water quality index which only has one year of measurement, so you have great variability in the various indicators that are out there"* (personal communication, September 30, 2014). Canada is a large country geographically with many regions displaying unique environmental profiles. The ability to address each presents a problem when trying to develop a national index.

4.5 Scalability

Scalability is often a controversial point of discussion when it comes to wellbeing indices. Well known indices like the CIW, GPI, GNH and HDI measure wellbeing on a large scale.

Community planners and decision makers are looking for something tailored towards the issues explicit to a specific area in order to make more effective policy decisions. There are merits to both large and small-scale indices; having an adaptable framework means that a good index can be adapted to a number of different populations, national, provincial, municipal, urban or rural. Many regions and municipalities in Canada have increased strategic sustainability initiatives and most work being done on sustainability planning is happening at the municipal level. According to Michalos, *"There are a lot of municipalities, states, regions where things are done that can't be done on a national level"* (personal communication, September 30, 2014). Therefore, it is crucial to acknowledge the importance of adaptability and scalability in wellbeing indices such as the CIW. Although national indicators have their place and purpose, the availability of data at the regional or local level means that a bottom up rather than top down approach may have more impact on the usefulness of indices such as the CIW. According to Waterloo planner Pierre Filion, the CIW is useful on a national level, but mainly for monitoring and discussion purposes *"Global data is not comparable necessarily for one country to the other, so they generally have to be broad indices and they are fairly meaningless" (*personal communication, September 17, 2014*).* Land use planners are often faced with the task of compiling evidence for proposed projects. Kevin Eby a planner for the Region of Waterloo said *"From a land use planning perspective it is hard to say I'm doing a specific task in order to accomplish what it says specifically in the CIW"* (personal communication, October 15, 2014).

When discussing the biggest changes that need to happen in order to increase the effectiveness of the CIW, Alexis Morgan discussed the need for consistent, meaningful, community data. *"The index would build the same way, but actually what gets gathered are things that can be compared throughout regions…even if it's not exactly the same info you can have limited comparisons by indexing things"* (personal communication, October 29, 2014). The CIW Ontario index had problems downscaling the environmental indicators of the CIW. Only two out of eight indicators were applicable to Ontario, GHG emissions and Ground Ozone levels. On protecting the environment, Eby said *"There are so many layers of government and other layers of organizations that are responsible for this so it's tough for us"* (personal communication, October 15, 2014). Local level decisions need to be met with local level monitoring. Mike Salvaris explains that the ANDI will be focused on community discussion. *"We have to open it up for*

discussion to the whole community, not just because you want to engage people, but because you will get better information" (personal communication, October 22, 2014).

Mark Anielski made an interesting observation when discussing the timeline of indicator development. Originally, wellbeing indices were developed internationally (GPI, Human Development Index, OECD, etc). Anielski, who has worked closely with several of these indices, says adapting a national index to a local level can make national indices more consistent. According to Anielski, "*There are ways to make a national index adaptable at a smaller level, then that way it is consistent across the board, or country, which makes our idea of wellbeing more consistent and well known"* (personal communication, November 14, 2014*).* Instead of downscaling national wellbeing indices, community wellbeing indicators could be based on specific community values and then from there, recurring or consistent community values could be translated into national values, rather than guessing which values are important nationally and measuring those general values or issues in specific communities.

Of several international and national indices, the Genuine Progress Indicator appears to have been the most successful at adapting its framework to the regional level. John Talberth explains that "*The costs and benefits of economic activity manifest at different level. The indicator [GPI 2.0] can be adjusted to reflect different variants in poverty using the GPI framework. It can be a meaningful metric at a local level"* (personal communication, October 27, 2014). Although there is value in the development of community level indicators, national indicators still have an important role to play. According to Talberth, it is still important for large-scale indicators to put everyone on the same page. *"We have gotten down to 6 important headline indicators that every country should be addressing; there is importance to dashboard indicators"* (personal communication, October 27, 2014).

One of the most interesting observations that was provided during the interviews was that from both Alexis Morgan from the CIW and Waterloo planner, Pierre Filion. Information from wellbeing indices like the CIW would be most valuable if comparisons could be made between regions of similar sizes. As a planner, Filion is interested in comparisons between areas of the same size, for example Waterloo and Hamilton. *"I would need more information for comparative purposes because generally I would have info for my region. I would like to have the same kind of variables for other regions and these comparisons do not currently exist"*

(personal communication, September 17, 2014). According to Alexis Morgan (using examples like the OECD) data that is comparable draws more attention from politicians. *"The nature audit showed media and politicians have a lot more time for you when you can compare how good or bad they are against each other. That competitive factor is really helpful… that's why the OECD resonates with people"* (personal communication, October 29 2014).

4.6 Index Results

The information derived from indicators in wellbeing indices refers to the numbers, facts, statistics and determinants used to make an assumption about wellbeing. How are we using this information? Can wellbeing indices that have an effective environment domain lead to better more strategic decisions about environmental sustainability within communities, regions, provinces, nations? It is important to not only address the type of information that is derived from indices such as the CIW but as well determine how this information can be used. Developers of the CIW insist that the environment is an important domain to measure despite its complexity and the many obstacles to finding good information. Those who developed the domain know that there are many environmental indicators available; the problem is that the information is difficult to access because of government policy. The role that government policy plays in indicator development is an important one. John Talberth explains the purpose of the Genuine Progress Indicator was always to affect policy. *"It's supposed to be related to policy analysis so when we have a piece of legislation like the climate action plan, it's supposed to give us a measurement of cost for those policy changes based on monetary values"* (personal communication, October 27, 2014). Better access to information might be achieved if the CIW could be adapted to regional concerns and supported by regional budgets. According to Alexis Morgan currently the CIW is run as an *"academic exercise"* (personal communication, October 29, 2014). Other wellbeing indices (ANDI, GPI) suggest that there are advantages to having an NGO policy advocacy goal within the index. Kevin Eby discusses the current process of land use planning. *"When we update our plans it's a matter of tracking backwards and what are the steps that can be done from a land use perspective that can have that impact"* (personal communication, October 15, 2014). Strategic planning involves looking at what has worked in the past and determining what changes need to

be made and a CIW adapted to regional land use planning can have an influence on how environmental sustainability factors into that planning.

John Talberth talks about the continual development of data sources and the importance of keeping wellbeing indicators up-to-date and current. "*We decided to make the start of the GPI studies from 2010 and up because there have been so many advances and new data sources that have come online in the last 10-15 years…everyone agrees we should go backward* (personal communication, October 27, 2014*).* Talberth continued to say that this constant flow of new data requires adaptable frameworks.

It has to be an adaptable framework that can incorporate new data as it comes along. I put much less emphasis on year-to-year continuity than I do just having the best data available. You don't need to compare prior years. Each year had to have the best available data (personal communication, October 27, 2014).

Waterloo planner Pierre Filion believes that year-to-year data collection is unnecessarily for certain indicators. *"If you are in a city that has good quality of life it doesn't vary from one year to the other. It's a bit like MacLean's ranking of universities, why does it vary so much from year to year? It doesn't"* (personal communication, September 17, 2014).

4.7 Communication of Results

Linking to the above section on index results, communication of the results involves determining how the information provided by indicators is interpreted. Depending on the intended purpose of any index, results must be communicated in a way that achieves the intended purpose. In order to stimulate discussion about the measurement of wellbeing, among all relevant stakeholders, index results need to be put into clear and simple terms. During the interviews, many key informants were understanding that indices such as the CIW cannot be a source of all information; the word "snapshot" was used quite frequently. Although in order for a wellbeing index to have credibility it had to have enough information and fact to support it.

There are merits to establishing an easy to read index to which members of the general public can relate. If there is one thing that the creators of the CIW put value in, it was the ability

of the index to communicate information to the public in a way that was understandable. According to Alex Michalos, *"Some people respond well to diagrams and pictures ... P2 and P6 don't mean anything to people compared to good and bad air quality"* (personal communication, September 30, 2014). Pierre Filion agreed when discussing the quantitative nature of the CIW, an often criticized area *..." it's a single number, its simple, its easy to understand so people grab that"* (personal communication, September 17, 2014). The over simplicity of indices was discussed during my interview with John Talberth from the Genuine Progress Indicator; he explained that a way to improve the commutation strategy of an index is to develop an general, yet adaptable framework where different communities can input specific information. "… *those 12 indicators are a framework for community engagement processes can fill in to say what are the most important social costs associated with economic activity. Its not the same in every area, what are the most important ecosystem services."* (personal communication, October 27, 2014).

4.8 Partnerships

The partnerships within wellbeing indices like the CIW, ANDI and GPI can be academic, financial or political. They can also be community partnerships. Partnerships are important if wellbeing indices are to earn credibility. Successful indicators cannot be put into practice effectively without the right partnerships and financial backing. One of the biggest problems with wellbeing indices is their translation from theory into practice. Cost effectiveness and overall effectiveness also appear to be closely related.

According to the interviewees, partnerships and financial agreements between wellbeing indices, public non-profit organizations and other public sector organizations are extremely important for the overall acceptance and use of indices by the public. Alex Michalos explained that half the funds allocated for the CIW from the Atkinson Foundation were put into ensuring the communicativeness of the index. *"We thought it wouldn't fly unless we had some people who knew about marketing and communication"* (personal communication, September 30, 2014). Partnerships between wellbeing indices and other public organizations are crucial for creating discussion and debate. Alexis Morgan explains the value in developing effective partnerships. *"The CIW is mostly run as an academic exercise. It is not run as an NGO policy advocacy piece.*

If you really want to create that, you have to get funding and drive a bunch of interest through the media and have bilateral conversations with other NGOs" (personal communication, October 29, 2014). Mike Salvaris from ANDI, which is currently in the development process, also acknowledges the value in financial and academic partnerships. *"We [ANDI] want to develop a partnership with universities to establish a center for progress research"* (personal communication, October 22, 2014).

4.9 Personal Recommendations and Opinions of Participants

After working with several wellbeing indices over a long period of time, most of the participants had informed recommendations, based on their time spent developing the indices. Alexis Morgan thought implementing food stocks and flows into the CIW would be important. *"The 3 biggest impacts on natural capital is converting it to one of those three forms [food, energy and water] and we tradeoff between those things"* (personal communication, October 29, 2014) He also thought that measures of overall consumption would improve the effectiveness of the environment domain because of the abundance of statistics available on consumption. *"Consumption levels should be included; those statistics are available through private corporations"* (personal communication, October 29, 2014). Morgan is confident that wellbeing indices will gain more respectability in the near future. *"I don't think we're that far away from it. At a federal level we need a regime change before this conversation would even be worth having but I don't think it's totally out of the realm of possibility"* (personal communication, October 29, 2014).

Pierre Filion admitted that planners should be more aware of the potential use of environmental indicators during the land use decision-making process. *"I think it's the planners' responsibility to try to explain what those indicators actually mean"* (personal communication, September 17th, 2014). John DeGraaf emphasized the importance of including measures of psychological wellbeing in any wellbeing index. *"It [the CIW] doesn't include psychological wellbeing… it is very important to have psychological wellbeing when talking about happiness"* (personal communication, December 9, 2014). According to DeGraff, *"We can look forever for a perfect system and it would be better in the short run I believe if we try to unify around a system*

and started using it consistently and then modify it more slowly; that would be beneficial" (personal communication, December 9, 2014).

4.10 Conclusion

The areas of concern identified by the key informants are important for understanding the underlying values in the development of wellbeing indices. The CIW, the GPI and the ANDI each employ unique ways of viewing wellbeing and developing ways to measure it. The more that is learned about the successes and challenges of each, the more likely it will be that wellbeing indices will become more effective at measuring what they are designed to measure. Awareness of the important elements of an effective wellbeing index can stimulate debate and discussion about how to improve wellbeing and this can lead to better and more strategic decision making at the community, regional, provincial and national levels. The environment has an impact on everything that humans value. Instead of viewing the environment as a separate entity, it must be seen as a crucial aspect of human wellbeing. How it is conceptualized in measures of wellbeing is an ongoing challenge.

Chapter 5 Recommendations for the Environment Domain

The purpose of this thesis was to gain a better understanding of the relationship between human wellbeing and the biophysical environment and how this understanding could translate into the development of strategic sustainability policy. Empirically, the thesis builds on the Environment Domain of the Canadian Index of Wellbeing, its purpose and how it could be made more relevant. Key informants who had knowledge and experience working with wellbeing indices as well as planners in the local Waterloo region were interviewed to gain some understanding of how the environmental indicators in the CIW could be useful for decision making at the local level. As a result of the interviews, it became apparent that a new organizational model was needed. The Environment Domain in the CIW could be made more relevant to decision makers by creating a new organizational framework that includes the following:

1. An examination of the drivers and pressures that result in changes to the state of the environment.

2. Impacts on the state of the environment and the responses that need to be considered.

3. The relationship of the environment to social and economic elements of Canadian society.

4. The flow of materials into and out of the environment that have an impact on its state.

5. The effects of the food production system on the environment.

6. The effects of the transportation system on the environment.

5.1 The Current Environment Domain

The final Environment Domain of the CIW consists of 8 indicators, although Alexis Morgan had originally suggested 14 primary indicators in the CIW Environment Domain report (2011). These indicators are grouped into "aspects" of the environment that are considered crucial for wellbeing. The 2011 report identified those aspects as being Air, Energy, Freshwater, Non-Renewable Materials and Biotic Resources and the indicators measuring those aspects include the following:

Air

- o Air Quality is measured by annual levels of Ground-Level Ozone.
- o Air Pollution is measured by the Criteria Air Contaminant Emissions Index (CAC) which measures levels of 7 air contaminant emissions (sulphur oxides, nitrous oxides, carbon monoxide, etc). It measures absolute emissions, indexed emissions and per capita emmissions. It compares the current state of air contaminants to 1994 and the pressures placed on the environment from per capita air contaminants and per economic sector.
- o The Greenhouse Gas (GHG) Emissions Index describes total GHG emissions per economic sector and is compared to Kyoto Targets.

Energy

- o The Primary Energy Production indicator shows the amount of different types of energy (hydro & nuclear, crude oil, coal etc) used over time.
- o Final Demand Energy Use shows energy use over time by different economic sectors.

Freshwater

- o The Water Quality Index describes the state of Canada's freshwater and provides an average water quality index score.
- o Water Supply Yield is based on Canada's annual average water renewal and measures the quantity of freshwater in Southern Canada since 1971.
- o The Residental Water Use indicator describes average total water use per person per day in litres within households. A Water Supply Variability Index shows variabiltiy across the country. The ratio of water intake to water yield is also presented for Canadian cities.

Non-Renewable Materials

- o The Viable Non-Renewable Energy Reserves Index measures reserves created to serve energy demand (coal, crude oil, bitumen, etc). The CIW substituted Ecological Footprint for the Viable Non-Renewable Energy Reserves Index in 2012.
- o The Viable Metal Reserves Index measures the amount of substances such as copper, nickel and zinc in reserve as well as annual depletions (extractions) or additions (new deposits discovered).
- o Combined Per Capita Waste Disposal measures the throughput of waste or how much can be repurposed per capita.

Biotic Resources

- o The Living Planet Index measures species population abundance categorized into birds, mammals, fish, reptiles & amphibians.
- o The Marine Trophic Index measures the mean trophic level of landed marine species. It measures the state of an ecosystem based on human demands.

o The Timber Sustainability Index measures the ratio of annual growth of standing timber to the total volume of harvesting, other development losses, forest fires and insect mortality. It measures the timber system addressing extraction and outputs based on different drivers.

The Ecological Footprint was added to the environment domain at very end of the indicator selection process. The Ecological Footprint measures the "productive" area being occupied by human infrastructure and acknowledges the renewable resources humanity is using and the ability of the earth to absorb this waste (Global Footprint Network, 2003-2015). This indicator does possess important attributes for measuring wellbeing and the environment as it accounts for human system; the use of land, creation of infrastructure and disposal of waste.

The criteria used to select the original 14 primary indicators were that they had to be scientifically reliable and valid via a peer review process, able to support benchmarking and monitoring over time, able to be updated annually, able to be spatially disaggregated, able to build upon existing data collection efforts, clearly defined, measureable, transparent and verifiable and sufficiently flexible to capture various aspects of natural capital, to represent both positive and negative activities and outcomes (Morgan, 2011, p.7). Because of the complexity of the domain and the breadth of Canada, the environment domain is the most difficult to disaggregate to any other geographical level. There also appears to be no discernable conceptual model that frames the domain and it was apparent from the interviews with Alex Michalos and Alexis Morgan that some indicators were selected simply because good quality data was available rather than because of some underlying framework or model (personal communication, October 29, 2014) and (personal communication, September 30, 2014).

Currently the CIW environment domain includes a mixture of indicators that demonstrates there are human activities that drive resource use, place pressures on the environment, and as a result of these pressures the state of the environment changes in terms of its physical attributes. However, most of the indicators are either pressure or state indicators and linkages among the indicators are neither explored nor measured. Because environmental indicators frequently only focus on revealing the state of the environment, assumptions must be made about the pressures that result in those states and the drivers of those pressures. Focusing on pressure indicators, provides important information about how states come to be; however it is the understanding of the drivers of those pressures that will ultimately lead to understanding the human activities that

need to be addressed. The Non-Renewable Materials indicators do not present a complete picture of impact on the environment especially in terms of waste and emmissions. The Viable Metal Reserves Index is considered a pressure indicator because it accounts for extractions; however, the output of extraction and its impact on biotic resources such as air, water and land is not accounted for. "The indicators within the environment domain can tell us if the state of our water or air quality is getting better or worse but it can't tell us why or how" (Michalos et al, 2011 p. v).

Within the domain there are unexplored connections among aspects of the environment that are being measured. The categories or aspects of the environment are treated as individual elements and not as part of a complicated system. Some aspects of the environment can serve as inputs to other aspects of the environment and some can serve as outputs and many environmental concerns can be viewed as either input or output problems. A challenging input problem involves resources with limited reserves being extracted and consumed at a rate that might not be sustainable. When extraction and consumption result in waste and emmissions it creates an output problem that can have a significant impact on critical elements of the environment. Consumers, business leaders and policy makers seem to be well aware of and concerned about the outputs of the industrial process (especially GHG emmissions) that are being dumped into the environment causing land, air and water pollution and which will ultimately effect the productivity of the biosphere.

There is no attempt to relate different aspects of the environment in the domain to one another, with outputs in one sector serving as inputs in another. There is also no attempt to show how there are both input and output problems that develop through the extraction or consumption of materials. Because the environment domain within the CIW lacks the systemic perspective that reveals the links between drivers, pressures, states and impacts, our understanding of the relationship between different aspects of the environment and human activities and the relationship between the environment and human wellbeing will be limited. There are also problems related to aggregation. The CIW uses a "mean of percentage change rate ratios scale". Percentage rates allow for trade-offs between the indicators that are deteriorating and those that are improving so that the state of the environment might be improving overall while some critical indicators like air quality might be deteriorating to such an extent that the impact on human health and wellbeing is seriously compromised. A new way of looking at indicators in the Environment Domain is needed

and a new framework which unerscores the importance of linkages among different aspects of the environment and linkages between the environment and other aspects of wellbeing is needed.

5.2 The Quest for a Sustainability Framework and Indicators

In 1987 the World Commission on Environment and Development or The Brundtland Commission released *Our Common Future* (WCED 1987) in which it concluded that there was a need for a new framework that would reconcile economic development with environmental protection. The report called for global structural changes to address the needs of developing countries and identified a need to strike a better balance between human and environmental wellbeing. The concept of economic development was to be rethought or re-conceptualized as sustainable development. According to the Commission, the environment has always been viewed as separate from human activity and development has always been perceived in terms of either political goals or economic progress. However, development and the environment are inextricably linked and should be understood in terms of human needs and the limitations of the environment to satisfy those needs. The Commission focused its attention on the areas of population, food security, the loss of species and genetic resources, energy, industry and human settlements and concluded that these are connected and cannot be treated in isolation from one another (pg. 27). It recognized that human resource development was crucial for environmental conservation and environmental limits to economic growth existed.

In 1992 the United Nations Conference on Environment and Development (UNCED) in Rio raised awareness of the need to integrate environment and development. The focus of the summit was to gain an understanding of how to orient the economy in order to achieve sustainable development on a global scale. In order to accomplish this, it called for the development of a new institutional framework for international cooperation. Global political commitment to sustainable development including economic growth, social improvement and environmental protection was called for in order to reduce poverty and create a fairer, more sustainable use of resources. Nations agreed to explore alternatives to GDP as a measure of wealth and take environmental and social factors into account. There was recognition that fundamental changes in the way that societies consume and produce was indispensable for achieving global sustainable development.

Specifically, Agenda 21 acknowledged the demand for the development of new frameworks that consider the important links between the three pillars of the economy, society and the environment in order to reduce climate change among G8 countries and identified these three pillars as the universal categories for sustainable development. Most of the current approaches to indicator development use this pillar model (Hak, Moldan & Dahl, 2007). A fourth (institutional) pillar can be added to account for the institutionalization and culture of developed countries. The importance of determining linkages among the pillars can be found in the fourth-pillar when two aspects of sustainable development are examined together; for example, environmental-economic, socio-economic, socio-environmental, economic-institutional, socio-institutional, environmental-institutional (Hak, Moldan & Dahl, 2007, p. 59).

The identification and organization of environmental indicators is crucial for communicating information that would be useful for policy development. However, policy decisions are often made using different time perspectives. The impact of policy decisions used to address social and economic issues are often felt immediately. However, it may take much longer for the impact of decisions made regarding the environment to become apparent. When decisions regarding the long-term sustainability of the environment must be made at the immediate expense of other aspects of wellbeing such as living standards or health, the short-term perspective is likely given greater weight (Hak, Moldan & Dahl, 2007). For example, limiting the use of transportation may result in decreased access to health care and job security. There can also be false senses of sustainability created within and across political boundaries. Spatial scales, borders and traded imports and exports magnify the complexity of the problems and "a local community can appear sustainable if it exports its unsustainable consumption or waste disposal" (Hak, Moldan & Dahl, 2007, p. 9). In order to be useful for policy relevance, Hak, Moldan & Dahl (2007) suggest a framework based on political rather than geographic boundaries.

> *Sustainability indicators may be easier to understand and interpret when assembled in some conceptual framework, perhaps with a hierarchical arrangement of sub domains. The three pillars (economic, social and environmental) are one such framework, but many others are possible. Such frameworks may reflect different values and weightings, which should be transparent. Frameworks may help to interrelate indicators from the natural and social sciences, to position both stock and rate indicators, and identify interlinkages. (Hak, Moldan & Dahl, 2007, p.9)*

Pillar models tend to focus on each pillar separately rather than the links and relationships needed between the domains to produce the most effective strategies (Hak, Moldan, & Dahl, 2007). A fundamental problem with the model is that it creates an artificial separation between three domains that are interconnected. Although the CIW's framework allows for tradeoffs between the domains, the Environment Domain is organized and measured independently from the others. Hak, Moldan & Dahl (2007) explain that this can lead to "unconscious assumptions of independence and commutability". Since the development of the three pillar model, variations on it have emerged. Decision makers are always looking for indicators that identify mutually reinforcing links between the three pillars and the challenge of quantifying these links has not been completely resolved (Hak, Moldan & Dahl, 2007).

The complexity of identifying and quantifying the linkages among the pillars has meant that sustainable development has been compartmentalized as an environmental issue. Development is still being defined primarily as economic growth and this is the framework that is used by developed countries. The dominant view of governments and business is that sustainable development is continued economic growth made more environmentally friendly in order to raise living standards. Economic growth is seen as part of the solution and what is often pursued is a balancing act between the environment and the economy with the economy remaining a separate entity from the environment. Effective integration of the three pillars has not yet occurred. Governments have not yet figured out how to create the required interdisciplinary integration required for sustainable development because sustainability is still seen as an environmental issue. A new model is needed to chart a path towards sustainability that is concerned with social equity, reducing resource use and integrating economic, environmental and social issues in decision making. Buy in from political leaders and a coherent cross government approach is needed. New metrics are needed to measure and report on the interconnectedness of various agendas and sustainable development needs to be taken out of the environmental box.

In the 2011 CIW Environment Report, Alexis Morgan (2011, p. 8) observed that government agencies do the best they can with limited data. Unfortunately, the data that is available or accessible is "insufficient to properly inform policy making when it comes to our environment and the broader wellbeing of Canadians". According to Morgan, there is a lack of strategic integration in the case of environmental monitoring. There is a need not only for better

stock and flow indicators but indicators that identify the systems that exist between human behaviours and the impact of these on the environment. The human - environment system is constantly evolving and there is a need to explore the cause-effect relationships between human systems and the biophysical environment. The exploration of this relationship is critical for the development of strategic policy that focuses on preserving and enhancing the environment. In order to affect policy, the environment domain within the CIW must be able to communicate evidence to decision makers of the direct or indirect impact that human activities have on the environment and what the drivers of those activities are. In order to improve policy making a better framework for measuring and understanding this complex relationship is needed. Both the DPSIR framework and Material Flows Analysis provide an interdiciplinary approach to measuring the environment by focusing on human activities and ecosystem services. They can be used as communication tools to inform the public and policy makers about the relationship between human activities and environmental burdens and they can be adapted for both large and small scale decision making.

5.3 The DPSIR Approach

In the late 1990s, the OECD proposed the Driver-Pressure-State-Impact-Response (DPSIR) framework as a means of organizing indicator information in a way that would prove meaningful for decision makers (Tscherning, Helming, Krippner, Sieber & Paloma, 2012). It was built on the 1993 Pressure-State-Response (PSR) framework proposed by the OECD and the Driver-State-Response (DSR) framework proposed by the United Nations (Tscherning et al, 2012). In 1995 the DPSIR framework was adopted by the European Environmental Agency as a way to illustrate the cause-effect relationship between human needs and environmental impacts and the DPSIR framework is the most common indicator system used in the EU.
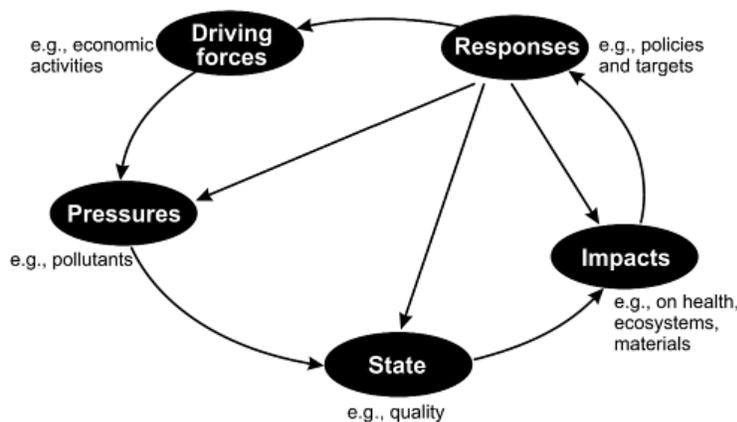
(Tscherning et al., 2012, p. 12, Figure 3,)

The DPSIR framework groups indicators into drivers, pressures, states, impacts and responses to describe how human activities affect the environment. The framework was designed to provide policy makers with the information they needed to make better decisions about the kinds of human activity that might need to be addressed in order to protect the environment. **Drivers** are the force behind the actions of humans on the environment. They can be basic needs that humans have for things such as food, water and transportation, but there are also cultural drivers such as the developed world's demand for material consumption. These drivers function through activites which cause **pressures.** These activities put stress on the biophysical environment through resource consumption, energy consumption, waste and emissions and land use changes. When pressure becomes overwhelming a condition known as a state develops. **States** are physical changes to the environment as well as biological changes to ecosystems, habitats, species or biodiversity. Changes in state create an **impact** on the wellbeing of humans through changes in the provisons of ecosystem services. Impacts can be social, economic or environmental and trigger societal **responses,** which can take the form of trying to mitigate or adapt to the changes in the state. Responses can also result in policy changes that can create new drivers. Tscherning et al (2012) provides an illustration of the DPSIR framework to address the issue of developing a bio-energy production policy.

A policy is introduced to subsidize bio-energy production (driver). Farmers begin cultivating large areas of bio-energy crops, which leads to pressure on the land. The land use changes from food production to bio-energy crop production; thus the state of land, the environment and outcome changes to being characterized by lower food production

and higher fertilizer use. The change in state leads to impacts in the areas of food security, health and demography that need to be assessed. A way to address undesired impacts is to create, as a response a policy that introduces incentives for food production. (Tscherning et al., 2012, p. 103).

The DPSIR framework was used in the identification and selection of sustainable development indicators in the United Nations report *Indicators of Sustainable Development: Framework and Methodologies* (Commission on Sustainable Development, 2001). The DPSIR framework can be used with the triple bottom line approach by measuring the driving force indicators, pressure indicators, state indicators, impact and response indicators for social, environmental and economic concerns. The DPSIR framework provides an interdisciplinary approach to development projects. It can been applied at global, national and regional levels and is commonly used in studies involving the management of marine environments as well as in the agricultural and rural sectors (Tscherning et al., 2007). It identifies the role played by key elements in the process and goes beyond the use of stock and flow indicators recommended by experts. Although the DPSIR framework addresses causal relationships between indicators, proponents of the use of the framework are in the early stage of collecting data and developing models necessary to integrate indicators into this type of framework (Hak, Moldan & Dahl, 2007). A mixture of pressure and state indicators have been identified in the CIW and two State-Pressure-Response Models, *Human Environmental Impacts Activity and the Environment* and *State of the Environment (1991, 1996)* were referenced in the Canadian Index of Wellbeing Technical Paper (Michalos et al., 2011).

5.4 Socio-economic Metabolism

Human society can be described as an organism, extracting resources for its maintenance and reproduction from the natural environment (for food, buildings, energy, heating, etc.) to finally return them into nature in the form of waste and emissions. This process, termed, 'social metabolism' refers to the flows of materials and energy between society and nature (Schandl, Grunbuhel, Harberl & Weisz, 2002). What makes societies different from living organisms is that they can organize this 'throughput' (mobilized by labour) by changing the parameters or natural process to gain more effective access to environmental resources (Schandl et al., 2002). Social systems can be viewed from the perspective of the process of extraction of raw materials from

their domestic origin (nature) or retrieving them from other societal economies and then transforming these raw materials in an economic process to provide material goods for both domestic and foreign demands (Schandl et al., 2002). The materials that stay in the economy for longer than a year are considered 'stock' (human population, livestock, infrastructure, machines, etc.) while flows refers to the inputs that are required to maintain or reproduce these stocks (Schandl et al., 2002). There are two potential sustainability problems with this process; resource scarcity at the input side and the capacity of the environment to absorb the waste and emissions at the output side.

Policy makers would benefit from viewing environmental problems from the perspective of societal metabolism in order for them to gain a sense of the capacity of the environment to endure the extraction, processing, consumption and waste that is the result of economic activity. Current interest in understanding societal metabolism has resulted in interest in developing a universal framework to better explain the physical dimensions of the economy and society including its interactions with nature. The figure below illustrates the different flows of the fossil fuels, minerals and biomass within an economy. It is a simplified rendering of material flow analysis, but can be useful in explaining the process to members of the general public and policy makers interested in   understanding the relationship between the environment and the economy (Figure 5, Eurostat, 2001, p.16).

Figure 5: Economy-wide material balance scheme (excluding air and water flows)

input	economy	output
domestic extraction: • fossil fuels • minerals • biomass	**material accumulation** (net addition to stock)	
	material throughput (per year)	**to nature:** • emissions to air • waste landfilled • emissions to water • dissipative flows
unused domestic extraction		*unused domestic extraction*
imports		**exports**
	recycling	
indirect flows associated to imports		indirect flows associated to exports

The concept of social metabolism provides a theoretical framework for Material Flow Accounting/Analysis (MFA). Material flow indicators can measure the progress of resource efficiency within an economy during the production and consumption line. Raw materials are resources extracted from natural resource stocks or from stocks that have been imported (OECD, 2008). These materials then become priced goods that are traded, processed and used within the economy. Some materials accumulate and are stored in the form of infrastructure or durable or semi durable goods such as vehicles (OECD, 2008). These materials eventually leave the economy as an output either to the environment (as waste) or to the rest of the world as exports (OECD, 2008, p.13).

5.5 Material Flow Analysis

Material Flow Analysis (MFA) views the economy and society as an open system of matter and energy exchanges entering and leaving the system which is embedded in the environment. MFA is able to provide detailed information about the physical flow of materials and energy into, through and out of an economy and is often used when determining the efficiency of natural

resource, energy and waste production (OECD, 2008). Material Flow Accounting is "an aggregate overview, in tonnes, of annual material inputs and outputs of an economy including inputs from the natural environment and outputs to the environment and the physical amounts of imports and exports" (Eurostat, 2001, p.15). It covers all material inputs with the exception of water and air of a national economy in tonnes per year (Eurostat, 2001). Input is measured by the materials domestically extracted and imports. The economy is measured by material accumulation and outputs are measured by air emissions, waste disposal and exports. It uses the principle of mass balancing to analyze material flows within complex systems such as food and transportation and includes tools such as Substance Flow Analysis, Material System Analysis, Life Cycle Assessments and Input – Output analysis (OECD, 2008). The model has been integrated into systems of environmental headline indicators for The European Commission and the World Resources Institute and is being implimented in Austria, Denmark, Finland, Germany, Italy, Sweden, and the United Kingdom (Singh & Eisenmenger, 2010).

The principle of mass balancing is based on the conservation of matter; matter can be transformed into other matter or into energy but can never disappear.Material supplies are accounted for in natural units instead of monetary units and are used to balance the supply of available inputs with targeted outputs. By accounting for materials entering or leaving the system, mass flows can be identified. The mass that enters a system must either leave the system or accumulate within the system so that input = output + accumulation. For the principle of mass balancing to apply, the boundaries of the system must be clearly defined. Energy that is taken out of the environment must reappear elsewhere in the system although its form might be changed so that it appears as waste. Because the environment is able to assimilate waste, some wastes are returned to nature. The environment has a large waste assimilation capacity but it is not infinite. All inputs used in production will result in equivalent waste. Mass inputs must equal mass outputs for every process. The economics of the environment is concerned with the allocation of resources among alternative uses in such a way as there is an efficient reduction of waste.

The term 'industrial metabolism' refers to the flow of materials and energy in modern industrial society through a system of extraction, production, consumption and disposal (Fischer-Kowalski, 1998). Industrial metabolism is used in physics, chemistry and engineering as well as industrial ecology. In the 1960s an increased awareness of environmental issues and a more critical

view of economic growth began to gain attention (Fischer-Kowalski, 1998). Since the 1960s there has been more and more research dealing with industrial metabolism and how to measure it for policy purposes. Material Flow Analysis is used as a tool for understanding and analyzing these processes between society and nature described in the industrial and societal metabolism models. MFA uses indicators to measure these flows in order to be used for policy decision making purposes. Economy-wide MFA compliments existing systems of national accounts of consumption and production by introducing a compatible system of biophysical accounts (Weisz et al., 2006). Only flows that cross the system boundary of the economy are recorded in the economy-wide MFA making it adaptable to policy intervention in a country like Canada.

5.5.1 Classic MFA Indicators

In 2001 the European Commission published a methodological guide to material flow accounts grouping indicators into input, output and stocks then into resources and uses. The flows that add to the amount of material in the economy such as domestic extraction and imports as well as unused extraction are regarded as *resources* (Eurostat, 2001). The flows that reduce the amount of materials in the economy, such as exports and emissions, accumulation of resources and the balancing of resources are presented as *uses* (Eurostat, 2001). Resources and uses can also be viewed as states and pressures in the DPSIR framework. A set of indicators can be derived from the material balance to provide a picture of 'industrial metabolism'. Three main indicator categories Inputs, Consumption and Outputs can be applied to the Envionment Domain of the CIW. Definitions for these indicators were taken from the Eurostat methodological guide, '*Economy-wide Material Flow Accounts and Derived Indicators'* (Eurostat, *2001*).

Input Indicators

1) Domestic Extraction (DE) – is the annual amount of raw materials (except water and air) extracted from a country to be used as materials for inputs into the economy. The term 'used' refers to an input for use in the economy, whether or not the material is used as a final product (Weisz et al., 2006).

2) Domestic Material Input (DMI) – measures the direct input of materials for use into the economy, i.e. all materials which are of economic value and are used in production and consumption activities. DMI equals domestic (used) extraction plus imports.

3) Physical Imports – measures all imported commodities in tonnes. Traded commodities comprise goods at all stages of processing from raw materials to final products. Exports can be categorized as raw materials, semi-manufactured products, finished products, other products, packaging material exported with products, waste exported for final treatment and disposal.

Consumption Indicators

1) Domestic Material Consumption (DMC) – measures the total amount of material directly used in an economy (excluding indirect flows). Domestic Material Consumption (DMC) can be calculated to reflect aggregate mass of all four material categories, but it can also be calculated for a single material category such as biomass. This also applies to all other indicators.

2) Net Additions to Stock (NAS) – measures the physical growth of the economy, i.e. the quantity (weight) of new construction materials used in buildings and other infrastructure, and materials incorported into new durable goods such as cars, industrial machinery and household appliances. Materials are added to the economy's stock each year (gross additions) and old materials are removed from stock as buildings that are demolished and durable goods disposed of (removals). These decommissioned materials, if not recycled are accounted for in Domestic Processesd Output (DPO).

Output Indicators

1) Domestic Processed Output (DPO) – measures the total weight of materials extracted from the domestic environment or imported, which have been used in the domestic economy, before flowing back into the environment. These flows occur at the processing, manufacturing, use and final disposal stages of the production-consumption chain.

Included in DPO are the emissions to air, industrial and household wastes deposited in landfills, material loads in waste water and materials dispersed into the environment as a result of product use (dissipative flows). Recycled material flows in the economy (metals, paper and glass) are not included in DPO. There is a fraction of some dissipative flows like manure and fertiliser that are recycled plant growth, but this cannot be estimated.

2) Physical Exports – measures all exported commodities in tonnes. Traded commodities comprise goods at all stages of processing from raw materials to final products. Exports can be categorized by raw materials, semi-manufactured products, finished products, other products, packaging material exported with products, waste exported for final treatment and disposal.

Table 1 of "*The Physical Economy of the European Union: Cross-Country Comaprison and Determinants of Material Consumption*" (Weisz et al., 2006, p. 680) summarizes how the following four materials are categorized.

1) Biomass
2) Construction Materials
3) Mineral Materials
4) Fossil Fuels

Table 1
Classification of material flows

Main material categories	Subcategories	Aggregated items
Biomass	Food	All potentially edible biomass from cropland plus traded food products
	Feed	All biomass from grassland, by-products and crops exclusively used for feeding livestock plus traded fodder
	Animals	All caught "wild" animals (in particular fish catch) and all traded livestock and animal products, including fish
	Wood	Harvested wood and traded wood-based products including paper, furniture, etc.
	Other biomass	Fibres and highly manufactured traded products predominantly from biomass
Fossil fuels	Coal	All types of coal
	Oil	All types of oil
	Natural gas	All types of natural gas
	Other fossils	Peat and highly manufactured traded products predominantly from fossil fuels
Industrial minerals	Industrial minerals	All types of metallic ores and metal-based products
	Ores	All non-metallic minerals used predominantly for industrial processes (excluding fossil fuels)
Construction minerals	Construction minerals	All minerals used primarily in construction

(Table 1, Weisz et al., 2006. p. 680)

Domestic material consumption (DMC) can be calculated to reflect aggregate mass of all four material categories, but it can also be calculated for single material categories such as DMC for Biomass when measuring the food system. In relation to the DPSIR model, MFA indicators are pressure indicators. The purpose of MFA indicators is to measure the pressures on the environment and their relationship to specific human activities and show the connections between the different pressures within the socio-economic system.

5.5.2 Addressing Scale

An important discussion surrounding national wellbeing indices like the CIW concerns scalability. Can the same indicators be used at the national, regional and municipal levels? Scalability is an important consideration when comparisons must be made among different geographic or political entities. The growth in economic trade has shifted many policy issues from local to national and global levels, and material flow analysis is often applied at a national level. MFA can be applied to all resource monitoring and collection systems using various instruments, can examine resources and products flowing through a system as well as the flows of specific materials and can be applied globally as well as to a specific country, industry, city or even a river basin (OECD, 2008). The 2008 OECD Report: *Measuring Material Flows and Resource Productivity,* refers to the two scales as 'meso' and 'micro'. Meso level MFA refers to large scale measurements that track structural changes at national or global levels by monitoring developments in resource productivity and environmental performance to support discussion (OECD, 2008). At the micro level MFA provides detailed information for specific decision making at the local level such as the city, region or municipality (OECD, 2008). MFA can also be used to clarify issues that spread across different political or geographic areas such as cities, regions and provinces giving these different geographical areas the opportunity to develop strategic plans across the country. MFA is useful for the development of economic, trade and technological development policies, natural resource mangement policies and environmental policies (OECD, 2008). Methods for organizing indicators are becoming more standardized and the resulting policy decisions are beginning to exhibit clearer direction and more focused targets (Hak, Moldan & Dahl, 2007). However clear direction and focused targets may be necessary but not sufficient for an emerging and complex topic such as sustainable development and there may be some trial and

error involved before the most efficient and effective indicators for a particular area are discovered. "Each country or institution must select indicators and frameworks based on specific needs, priorities… this is the only way to ensure a more equitable and sustainable society for future generations" (Hak, Moldan & Dahl, 2007, p. 14).

5.5.3 MFA Relevance to Policy

MFA indicators are useful for policy development because they can identify and describe material flows and material resource use in connection with specific human activites. MFA can examine resources and products flowing through a system as well as the flows of specific materials and can be applied globally as well as to a specific country, industry or city (OECD, 2008). In recent years the term resource decoupling has been used when discussing strategic development. The OECD was the first to adopt the decoupling concept as a main objective in the 2001 policy paper *Environmental Strategy for the First Decade of the 21st Century*. The concept of decoupling evolved from life cycle analysis and focuses on reducing the environmental impact of goods throughout the good's entire life cycle from production to consumption to disposal. There are two types of decoupling, impact and resource. Impact decoupling can estimate impacts from economic activity on four main pressures (resource use, energy use, land use changes and waste & emissions). Impact decoupling means that negative environmental impacts decline while value is added in economic terms (OECD, 2011). Impact decoupling may mean using a larger amount of resources, but using them more effectively. An absolute reduction of resource use is rare given the ever increasing demand for goods and services (OECD, 2011). Reduction can only occur when the growth rate of resource productivity exceeds the growth rate of the economy; resource decoupling seeks to reduce the rate of resource depletion, which can be important when a scarce resource continues to be in high demand such as oil (OECD, 2011). There are both positive and negative aspects to both decoupling methods depending on the specific situation, however the concept of decoupling can be instrumental in policy development.

5.5.4 Application of MFA in EU Sustainable Development Strategy

Article 6 of the EU Treaty states that environmental protection requirements must be integrated into the definition and implementation of EU policies and activities. Environmental policy integration means that environmental issues must be reflected in all policy decisions (Hak, Moldan, & Dahl, 2007). It is the EU's Sustainable Development Strategy and the EUs governnance agenda to develop a broad framework for promoting the integration of economic, social and environmental objectives in Europe (Hak, Moldan, & Dahl, 2007). The European Comission Report on material flow accounts explains that MFA indicators are designed to complement other environmental accounts already in place to direct policy decisions (Eurostat, 2001). Organizing existing data sets from the Environment Domain such as accounts for timber, water quality or air emissions into an accounting framework like the MFA provides consistency as well as:

- provides insights into the structure and change over time of the physical metabolism of economics
- allows for the measurement of the developed world's material intensity of lifestyles, by relating aggregate resource use indicators to population size and other demographic indicators
- derives indicators for resource productivity and eco-efficiency by relating aggregate resource use indicators to GDP and other economic and social indicators
- contributes to organizing, structuring and integrating available primary data and ensures their consistency
- estimates the material flows and land use induced by imports and exports

The Open Working Group (OWG) on Sustainable Development Goals (SDG) released 17 goals with 169 targets focused on improving global sustainability initatives, 40 of which are focused on policy integration (Leadership Council of the Sustainable Development Solutions Network, 2015). It is expected that governments around the world will adopt the SDGs in September 2015 and begin implimenting strategies in January 2016 to achieve the 17 goals (Leadership Council of the Sustainable Development Solutions Network, 2015). The SDG indicators were selected in part with the OECD and the European Commission in order to review indicator options for the acknowledged obstacles (Leadership Council of the Sustainable Development Solutions Network, 2015).

Wellbeing indices must allow for tradeoffs between relevance to users and policy implications, statistical quality, analytical soundness and scientific coherence. Because they are

used to "communicate to a non-expert audience, they must be understandable and meaningful and be able to reduce the complexity and level of detail in the original data" (OECD, 2008, p. 56). Certain indicators can provide policy makers with the informaton they need to understand the underlying causes of environmental burden but lack the ability to generate discussion. The MFA framework and organization can demonstrate how environmental indicators relate to prevaling economic structures and may prompt decision makers to develop ways to releave environmental problems, reduce inefficiencies in material use, improve resource efficiency and reduce the amount of waste that cannot be recycled back into the system.

5.5.5 MFA for Improvement of Ecosystem Services

Ecosystem services are often referred to as the direct and indirect contributions of ecosystems to human wellbeing, quality of life, and basic human survival. According to the United Nations, ecosystem services are the benefits people obtain from ecosystems, which can be categorized into provisioning, regulating and cultural services in the Millennium Ecosystem Assessment (OECD, 2001). The concept of creating policies for ecosystem services is often criticized because of its anthropocentric nature; the idea that humans are only interested in saving the resources that are useful for human consumption. However, given the anthropocentric nature of the CIW it is appropriate to view the natural resources measured in the Environment Domain through an ecosystem services perspective. Ecosystem services are often referred to as the direct and indirect contributions of ecosystems to human wellbeing, quality of life, and basic human survival.

One of the major challenges identified by the Millennium Ecosystem Assessment from the standpoint of linkages between people and ecosystems involve land use changes. Between 1960 and 2000 the world population doubled resulting in increased needs for food and water (UNEP, 2013). During this time water use doubled and food production more than doubled. This dramatic growth in the human demand for food and water has resulted in rapidly increasing changes in land use. More land has been converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850 (UNEP, 2013). Cultivated systems (areas where at least 30% of the landscape is in cropland, shifting cultivation, confined livestock production or freshwater aquaculture) now cover a quarter of the Earth's terrestrial surface (UNEP, 2013). This results in

rapid changes in forest land cover and land degradation. Increased production of crops and livestock has been accomplished by new technology, new crop varieties, fertilization and irrigation as well as increasing the area managed in the case of crop and livestock production (UNEP, 2013). Not only has the development of agriculture reduced the numbers of malnourished people and improved human health, it has been critical to the strategic development of many third world countries, providing revenue that has enabled investment and alleviated poverty (UNEP, 2013).

Because increases in food production involve increased use of water and fertilizer and the expansion of cultivated land, other ecosystem services have been affected. It has reduced the availability of water for other uses; degraded water quality, reduced biodiviersity and decreased forest cover leading to the loss of forest products and the release of greenhouse gases (UNEP, 2013). The conversion of forest to agriculture can also significantly change the frequency and magnitude of flooding depending on the type of land cover change. Dryland ecosystems are particularly fragile but they are also places where the human population is growing most rapidly, biological productivity is the least and poverty is the highest. The extent of land degradation is a critically important feature of ecosystem change at a global level. Dryland systems cover about 40% of earth's land surface and more than 2 billion people inhabit them, with 90% living in developing countries (UNEP, 2013). Dryland ecosystems have experienced the highest population growth rate of any systems examined (UNEP, 2013). They are home to one third of the human population but have access to only 8% of the world's water supply and according to the Millennium Ecosystem Assessment, pressures on dryland ecosystems are growing (UNEP, 2013).

MFA indicators can provide information on how to maintain the integrity of an ecosystem and the provision of ecosystem services (OECD, 2008). By measuring the environment domain through the input, consumption and output flows of renewable resources, an appropriate level of regeneration can be maintained which can result in an improvement in the carrying capacity of human activities. It can improve natural productivity and decrease the amount of pollution and waste generated by the extraction of ecosystem services; as well as support the provision of recreation and non-market ecosystem services (OECD, 2008, p.33). Using MFA as a tool to measure inputs, consumption and outputs of materials in Canadian society can reveal important information about the environment, society and wellbeing specifically and can be related to the three pillars of sustainable development (economic, social and environmental).

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5.6 New Areas to Consider: Food and Transportation

Two specific systems important to Canadian wellbeing are the food and transportation systems. Both systems are directly related to living standards, health, leisure and culture, time use and community vitality, as well as indirectly linked to education and democratic engagement. Both transportation and food are at the forefront of sustainability discussions and both areas have been considered for the 2015 United Nations Sustainable Development Goals (SDGs) and in the 2013 European Union Sustainable Development Strategy. Both systems are largely dependent on natural resource consumption, energy and land use and both are considerable emitters of waste and emissions into the environment. Transportation is often considered the most important system to examine when identifying ways to limit citizen impacts on climate change (Hametner et al., 2011). Food is a system that is often overlooked when discussing consumption habits that could be modified in developed countries. Because of this, both are important to consider when discussing the nature of the Canadian environment. Both food and transportation are critical to Canadian wellbeing and the systems that have evolved in Canada place enormous pressure on the environment. Dr. Rajendra Pachauri, Former chair of the Intergovernmental Panel on Climate Change made a statement about the increasing importance to acknowledge food and transportation.

> *People who want to make their own contribution in the fight against climate change usually concentrate their efforts on reducing emissions in the transport sector; often ignoring that appropriately changing their eating habits could reduce their emissions to an even greater extent.* - (Barilla et al., 2013)

The Environmental Impacts of Products (EIPRO) project was adopted by the European Commission Joint Research Centre (DG JRC) in order to identify products that have the greatest environmental impact using a life cycle approach; "impacts of the production, use and waste management phases of products and services ultimately consumed" (Tukker & Jansen, 2006 p.161). Combining the methodological approaches of existing, as well as new studies, there were three consumption categories in the EU identified as having the greatest impact on the environment; food, transportation and housing. These three categories that account for approximately 70% of "the total lifecycle impacts of all products and services used for final household and government consumption" (p. 175). For this study I did not recommend indicators for housing because this category is already represented in the CIW in the 'Living Standards'

domain. Further research is required to address this area of Canadian life and how to represent it in two different domains.

5.7 Food

Food is critical for human wellbeing and the food production system has an important impact on the environment. This impact is felt on virtually all natural resources air, land, water, sun and energy. The extraction, harvesting, production, transportation, consumption and disposal of food are all linked to wellbeing through environmental and health related consequences. Often when food is discussed from a policy perspective food security is the main concern; having enough food to feed a growing population. A growing global population and increased living standards in the developed world have resulted in demand for a high quality, abundant and diverse selection of food. These drivers have created pressures in the form of natural resource consumption, land use changes, energy consumption and waste.

5.7.1 Diet, Trade & Security

Food links the environment to wellbeing in several ways. It is a basic necessity of life and is a contributor to not only physical health but as well social and cultural wellbeing. Social, economic and cultural values are expressed through the selection, presentation and consumption of food throughout the world. Food plays an important role in cultural rituals and religious ceremonies both domestically and internationally. Alexis Morgan discussed the possibility of including food indicators in the original development of the environment domain, although he believed at the time that there were too many obstacles to overcome in the development of effective indicators (Morgan, 2011, pg. iii). It may be worthwhile to try to overcome these obstacles. The importance of creating a system where all people have access to enough safe and nutritious food to meet their needs is a priority of many national and international organizations. The emphasis on food security as a priority must be balanced with concerns about the environment resulting from the industrialization of the agriculture sector (Porter, et al., 2014). Agriculture is the biggest driver behind land use changes and the over consumption of ecosystem services, making the food system

an important consideration when measuring both wellbeing and the environment (Porter, et al., 2014).

There are a number of environmental drivers affecting both the domestic and the global food systems. Soil fertility, temperature, carbon dioxide levels, precipitation and land space are often contributing factors to increases in food production, food prices and food availability (Porter, et al., 2014). The Intergovernmental Panel on Climate Change (2014) found that a 19% increase in food prices was the result of changing temperatures and precipitation trends on food supply (Porter, et al., 2014). As living standards in developed countries increase, the demand for food increases and becomes harder to control. In developed countries like Canada, leisure and culture have become important drivers of the food system. Food is consumed as a social event and it has become a societal norm to "go out for drinks" or "get a bite to eat". For a developed country like Canada, scarcity of food is seen as much less of a problem than in countries that have larger population densities and scarcer resources.

Wellbeing in Canada may depend not as much on quantity of food produced but type and quality of food produced. The Canadian food system is capable of producing much more food than is needed by Canadian consumers for survival and is heavily involved in the international trade of food products. The increasing Canadian consumer demand for off season fruits and vegetables and foods native to other countries places demands on the system for exports. Canada is also a primary exporter of beef and pork. The developing world's demand for certain foods such as Canadian meat and dairy products places pressures on the Canadian environment resulting in changes to land area, energy and natural resources and the production of waste and emissions. The production of meat alone places huge demands on water and energy resources and plays a major role in the Canadian economy. In 2012, Canada exported $4.22 billion of pork and beef to more than 71 different countries (World Watch Institute, 2014). The production of meat alone places pressure on the environment all along the production and consumption cycle starting with the harvesting of grain for animal feed to final consumption waste and/or export.

As different drivers increase the demand for certain types of food, the agricultural sector in developed nations has become more highly industrialized in order to increase production while at the same time maintaining efficiency and this has had both a direct and indirect impact on natural capital. In Northern and Western Europe, farmland bird species are in decline due to the lack of

incentives for maintaining high nature value farmland and the increasing use of biomass for the production of renewable energy (Eurostat, 2013, p.15). Examining drivers in the food supply which result in environmental pressures can provide an understanding of how environmental resources are being used in the food system and increase our understanding of how the system can be improved without sacrificing the environment.

5.7.2 Food as a System

In the manufacturing of a final consumption product like food, many processes take place in differing production systems that can have a variety of different environmental impacts. Often when the food system is envisioned it takes the form of a farm to plate scenario; however there are many other aspects of the food system that consume environmental resources and have an impact on natural capital that should be examined, measured and addressed. The Intergovernmental Panel on Climate Change Report (2014) refers to these as "non-production aspects" (Porter et al., 2014, p. 490). Unfortunately, because the system is so complex and far-reaching, it is easier to focus on single process performance rather than the food system as a whole (Gerbens-Leenes, Moll & Uiterkamp, 2003). Global food scarcity and a growing global population have prompted organizations such as the United Nations to call for better natural resources management in agriculture and the development of improved methods for assessing economic and environmental impacts from the food system. Understanding the different parts of the food system is important for understanding how to improve it. Good quality information on food flows can provide a basic understanding of the different environmental contributions to the system and how production, consumption and disposal can be improved. The figure below comes from the International Panel on Climate Change Report "*Climate Change 2014: Impacts, Adaptation, and Vulnerability*". It outlines the main divers that are divided into climate and non-climate elements which then trigger production in order to respond to food security issues. This figure gives specific examples using the DPSIR model, showing how drivers and responses can also be categorized and identified to show the most important links for decision makers.
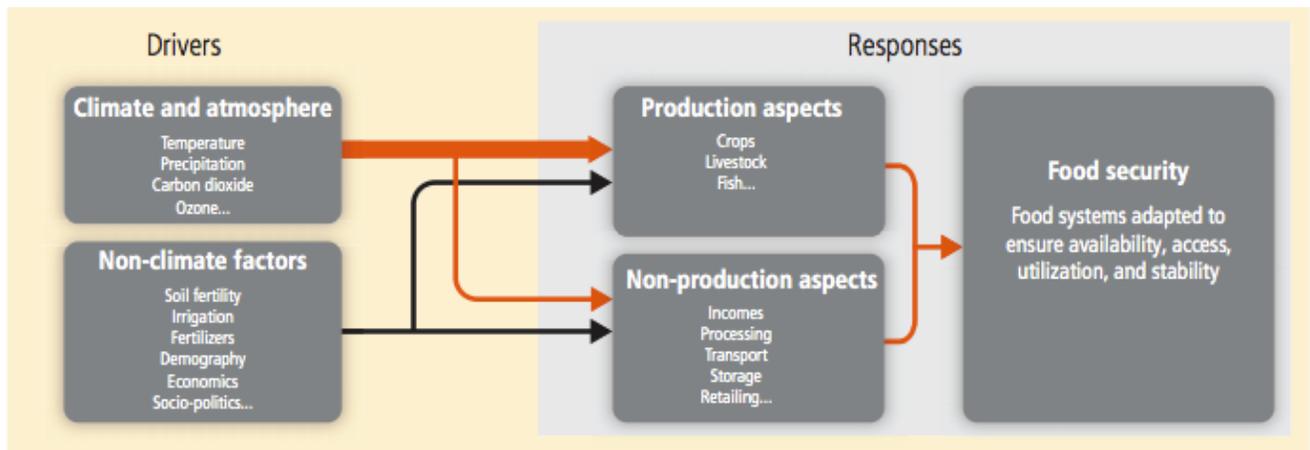
Figure 7-1 | Main issues of the chapter. Drivers are divided into climate and non-climate elements, affecting production and non-production elements of food systems, thereafter combining to provide food security. The thickness of the red lines is indicative of the relative availability of refereed publications on the two elements.

(Porter et al., 2014, p. 490 Figure 7-1, IPCC 2014 Report)

5.7.3 Material Flow Analysis and Food: The Concept of Biomass

Economy wide material flow accounts are compilations of all material inputs into an economy, the material accumulation within the economy and material outputs to other economies or to the environment. To identify the driving forces of national material use patterns and determine progress toward the sustainable use of resources, detailed material flows rather than highly aggregated indicators should be used (Weisz, et al., 2006, p. 679). Domestic material consumption (DMC) is domestic extraction plus imports minus exports. Material Flow Analysis considers food to be a subcategory of biomass and biomass is considered to be the most important of all socio-economic material flows. Biomass includes

- Food, edible biomass from cropland plus traded food products
- Feed, grassland, by-products and crops used for feeding livestock
- Animals, caught "wild" animals, traded livestock and animal products, fish
- Wood, harvested and traded, wood-based products including paper and furniture
- Other biomass such as fibres and highly manufactured traded products

(Weisz, et al., 2006, p.680)

Biomass is by far the most important renewable energy source. In the European Union, biomass accounts for 25% of total domestic material consumption and globally, agricultural production is the largest single cause of competitive land occupation (Weisz et al., 2006, p.684).

Biomass is largely dependent on land area availability and population density and "Biomass as raw material for food is virtually irreplaceable" (Weisz, et al., 2006, p. 684). The level of per capita biomass use in a country's economy depends on the availability of land, area productivity and efficiency, the relationship between competitive and non-competitive land use, size of livestock and the physical volume of biomass trade (Weisz et al., 2006, p.694). Agricultural biomass refers to the subcategories within biomass, which considers things like feed for animals and the energy used to produce meat or dairy products (Weisz, et al., 2006). Biomass flows are often highest in the production phase of the food system. Biomass production requires large quantities of water and land, and if not properly managed negative land use changes can result (Eurostat, 2013). Infrastructure is needed to preserve and store food and a transportation infrastructure is needed to ship food both domestically and internationally.

Trade has a significant impact on the level of domestic material consumption (DMC) for agricultural biomass. Earlier stages of the animal production chain (which starts with harvest of plant fodder) may take place in other countries and products may be imported at later stages of processing. The same level of meat consumption can be satisfied by either domestic livestock production or by imported meat. Large livestock does not necessarily mean high per capita extraction of agricultural biomass as highly processed fodder can be imported. A large proportion of edible biomass extraction is used as animal fodder. Imports at different stages of the production process reduce the weight of primary material inputs into a national economy which results in lower domestic material consumption DMC (Weisz, et al., 2006). Countries with the lowest per capita values of livestock extraction and domestic consumption have the most intensive land use systems, associated with comparatively high environmental pressures measured in terms of fertilizer application (Weisz, et al., 2006, p.688). In industrial economies only a few sectors are as materially intensive as livestock production. Population density is also an important factor closely related to material use. High population density results in high net imports and the externalization of materially intensive processes such as meat production (Weisz, et al., 2006, p.694). However even if a country is able to reduce its domestic material consumption of a materially intensive product such as meat, the high consumption of these products also results in high levels of waste and emissions due to effects of international trade and transportation. As accumulated materials will turn into emissions and waste at some point the indicative value of DMC is the waste potential

of a region and annual flows of waste potential. National waste potential will add to the environmental pressure within the national territory either now or at some time in the future or due to transboundary flows add to global environmental pressure (Weisz, et al., 2006, p. 696).

5.7.4 Current Application of Biomass Indicators

Current agricultural data both nationally and internationally is abundant and agricultural indicators are generally scientifically sound, accessible and useful. The United Nations have implemented a System of Environmental-Economic Accounting (SEEA) to measure the physical flow accounts, asset accounts and environmental activity accounts of the agricultural industry (Statistics Canada, 2014a). Environment accounts track expenditures related to environmental protection and management of natural resources (Statistics Canada, 2014a). The United Nations Food and Agricultural Organization (FAO) has also pushed for a new set of accounts looking at pesticide use, crop production, GHG emissions and land cover (Statistics Canada, 2014a). The OECD Compendium of Agri-environmental Indicators (2013) was created to inform policy makers and the general public about the state and trends in agri-environmental conditions and provide an aid to policy analysis (OECD, 2013). The indicators measured the environmental performance of the agricultural sectors in 34 OECD countries between 1990 and 2010 and included measures of Agricultural Production, Agricultural Land Use, Organic Farming, Transgenic Crops, Nutrients, Pesticides, Energy Consumption, Soil Erosion, Water Resources, Water Quality, Drinking Water Limits, Ammonia and Greenhouse Gas (OECD, 2013). The report focused on domestic agricultural production and emphasized natural resource consumption, energy consumption, waste/emissions and land use changes (OECD, 2013).

The European Commission treats biomass largely as bioenergy; "organic, non-fossil material of biological origin that can be used for heat production or electricity generation" (Eurostat, 2013). The European Commission classifies biomass into Crops, Crop Residues, Wood and Animals. The data sources for the selected biomass indicators were derived from agriculture, forestry and fishery statistics, farm surveys and statistics as well as the Food and Agriculture Organization statistical database (European Commission, 2013). Of 100 indicators developed, 11 are treated as headline indicators. The headline indicator for sustainable consumption and production is Resource Productivity and for Natural Resources it is Abundance of Common Birds

and Conservation of Fish Stocks. "The Commission's strategy and action plan, *Innovating for Sustainable Growth: A Bioeconomy for Europe* reconciles demands for sustainable agriculture and fisheries, food security and the sustainable use of renewable biological resources for industrial purposes while ensuring biodiversity and environmental protection" (Eurostat, 2013, p.94).

According to Erb et al., (2009) in a Working Paper *Eating the Planet: Feeding and Fuelling the World Sustainably, Fairly and Humanely* environmental indicators must be aimed at limiting the gap between overconsumption and malnourishment, reducing environmental pressures and producing plant biomass for energy solutions and protecting biodiversity (Erb, et al., 2009). Erb et al., (2009) examined different diets in an attempt to determine the effects of diet on the environment: A Western high meat diet, current diet trends, diets with less meat (30% animal protein) and fair less meat (20% animal protein). Three livestock systems were examined (intensive, humane farming and organic farming) and two land use changes (FAO expansion and massive expansion) and three Cropland yields (FAO intensive yields, wholly organic yields and intermediate yields). According to Erb et al., (2009) western high meat diets require massive land use change, intensive livestock production systems and intensive use of arable land. The authors concluded that diets have a strong effect on total bioenergy potential and that the share of animal products in human diets has a strong impact on the environment.

5.7.5 Canada's Food System

Canada possesses a higher economic growth rate than the majority of nations in the world and is also fortunate enough to have the lowest food prices in the world (OECD, 2013). Canada is the sixth largest exporter and sixth largest importer of agriculture and agri-food products, moving billions of dollars annually. For the purposes of the CIW, indicators that focus on domestic flows are appealing; however in order to gain an understanding of how Canada's food system is doing domestically an examination of imports and exports is crucial. Domestic food security relies on the security of biomass inputs and outputs.

Over 70% of all the food sold in Canada is produced domestically; this percentage is even higher for products that require high consumption of energy and natural resources like meat and dairy (Statistics Canada, 2012). The expanding food sector in Canada plus the increase in meat

and dairy production puts several pressures on the environment. Farmland affected by fertilizer and herbicide use has increased 200% since the 1970s (Statistics Canada, 2009). Water used in the Canadian agriculture sector accounts for 3.5% of the total water consumption in the entire country, 4.8 billion cubic meters annually (Statistics Canada, 2009). Greenhouse gases from the agriculture sector have also increased over 25% since 1990s (Statistics Canada, 2009). The province of Ontario is the third largest food-manufacturing sector in North America (FBO, 2015). The scale of the food sectors in both Canada and Ontario means an influx in new jobs which means both the federal and provincial governments are focused on doubling exports and growing the sector substantially by 2020 (Ontario Government, 2013).

Federal and provincial governments have taken many steps to improve the growth and efficiency of the agricultural sector, realizing that increased economic gain can be associated with increased environmental problems in terms of natural resource consumption, energy consumption, land use changes and increased emissions. Agricultural inputs and outputs have been identified in *An Overview of the Canadian Agriculture and Agri-Food System* (2011) The report outlines the natural resource use and environmental impacts associated with food production and the steps the country has taken in an attempt to mitigate pressure on the environment (Agriculture and Agri-Food Canada, 2011). These include:

- Implementing environmentally-friendly management practices that improve soil, water and air quality
- Adopting practices that reflect a low carbon pathway
- Reducing emissions per unit of agricultural production activity
- Monitoring wildlife habitat on farmland

In addition, several key policy initiatives have been implemented to increase the relevance of local food systems (Bill 36, Local Food Act 2013), emphasizing the need for healthy and sustainable food systems at a regional level (The Sustainable Food Systems Project), reducing GHG emissions in the Ontario agriculture sector (Ontario's Action Plan on Climate Change) and improving the health of Ontario residents through access to healthy food (Ontario's Action Plan for Health Care) (Veeramani, 2015).

Although policy makers are interested in developing effective environmental policy while sustaining the food system, a knowledge gap still exists between the specific drivers and pressures

associated with the food system. Material flow analysis can be used as a tool to identify the key divers and pressures associated with the Canadian food system in order to provide policy makers with a better understanding of how the environment is affected by Canadian diets, the effects of agriculture infrastructure and production and the source of GHG emissions. The Canadian Index of Wellbeing can also benefit from this information as the food system relates directly to health, living standards, leisure and culture as well as to the overall wellbeing of Canadians.

5.7.6 Proposed Food Indicators for Environment Domain of the CIW

It is difficult to develop indicators that measure the food system of a nation or even a local community because of the substantial amount of importing and exporting that takes place and many food systems are not monitored consistently; therefore, the identification of important drivers and pressures on the environment from food production is necessary. Pressure indicators for food come in the form of hectares or per capita measurements. For the food system these include: how the use of natural resources puts pressure on the fresh water supply during the production of meat and crops, the energy consumed during the production of specific agricultural products, the impact of increasingly sophisticated agricultural technology on food production and the environment, the waste and emissions produced by fertilizers, pesticides and livestock and how current agricultural practices have resulted in land use changes during a period of expansion. In order to be effective, food indicators must

1. acknowledge specific environmental pressures (natural resource use, energy use, land use changes)
2. acknowledge the effects of production, infrastructure and outputs and the system as a whole (processing and transportation of food)
3. possess policy leverage points (relate to human activity)
4. be able to communicate important information to policy makers and the general public
5. be scalable on different levels
6. be linked to building healthy communities and other relevant social criteria and other indicators in the CIW

Using the material flow logic, biomass flow accounts can be used to measure inputs, consumption and outputs of biomass in Canada. Both food consumption and production values are used to distinguish where biomass is being used and to determine which policy realm will be affected.

Input

- Domestic biomass input
- Total imports of Biomass
- Food imports – nutritional energy derived from imports by the total nutritional energy consumed by the population

Consumption

- Domestic biomass consumption per capita
- Food consumption – average amount and type of food consumed by people in the local system (per capita)
- Food production (production of edible plant and animal-based biomass) (GJ)
- Share of animal products in total food production
- Physical trade balance of biomass
- Net Additions to stock of biomass

Output

- Domestic processed biomass output
- Biomass extraction per capita (GJ per capita)
- Food output per capita (edible biomass ratio)
- Food exports relative to food production (share of nutritional energy exported from all the nutritional energy produced within the system. It is calculated by dividing exports by total calorific production.

From a policy perspective overall objectives, operational objectives and targets can be developed. Share of animal products in the total food production system can assist in limiting the over production and consumption of animal products. The actions/explanatory variables might be to offer subsidies to farmers to switch land use to something less intense than livestock. Contextual indicators might involve the social, cultural and political role that beef production has in the local area. There might be a need to develop additional indicators such as those that measure the benefits of organic farming on human health, water use, and farmland biodiversity. The development of effective indicators is an ongoing challenge. Consumer needs for specific food products are constantly changing. The evolution of the Canadian food system to meet those needs puts constant pressure on the environment in terms of the use of natural resources, energy use, land use changes and waste. A key challenge in developing effective indicators to determine the impact of the food system on the environment is the ever-increasing amount of global trade and the importing and exporting of food products. A key challenge for policy makers and the general public is to

determine if the effect of this production is a reasonable tradeoff when pressures on the environment are fully accounted for.

5.8 Transportation

Because of the impact of global trade on the food system as well as its impact on the exporting and importing of countless other products, the transportation system and its effect on the environment needs to be addressed. From a planning perspective, transportation is a key political and economic issue. Moving people within local communities and from community to community across provinces is enormously costly and complex and environmental problems can often be linked to poor urban design and short-term planning. Areas such as Waterloo Region have historically expanded outwards, building more family housing for growing populations and adding more shopping centers to serve new residential customers. The majority of Canadian cities are designed outwards requiring the use of a personal vehicle to commute to work, access grocery stores, social and cultural activities, health care and education. Larger cities like Toronto are primarily concerned with reducing or eliminating traffic congestion and are willing to allocate vast amounts of economic resources (in partnership with other levels of government) to the development of an efficient public transportation system. Other cities that are expanding rapidly are confronting similar problems but without the experience, resources and partnerships that many major urban centers enjoy. The current strategy in the Waterloo Region has been to increase pedestrian volume in the city centers of Kitchener and Waterloo and construct a new Light Rail Transit system to move people efficiently in and out of the region (Infrastructure Ontario, 2014). Efficient transportation systems are important to city planners looking to build more sustainable cities and the effects of the transportation system on the environment plays an important role. At the 2015 Sustainable Communities Conference held in London Ontario it became apparent that the main objective of many cities, regions and municipalities across the country was to build more effective transportation systems to reduce the impacts on climate change.

5.8.1 Drivers

In Canada, transportation has expanded largely around single passenger vehicles and the majority of infrastructure dollars are spent in the expansion of highways and roadways (Statistics Canada, 2014a). There are over 30,000,000 passenger and freight vehicles registered in Canada, including automobiles, buses, motorcycles, transport trucks and off-road vehicles (Statistics Canada, 2014a). Increasing amounts of infrastructure for these vehicles is needed and questions are being raised about the potential damaging effects of constant road construction and traffic on the health of Canadians and the environment. The European Union's Sustainable Development Strategy highlights transportation sustainability as "the ability to meet the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values today or in the future" (European Commission, 2015). "Transport, fulfills fundamental needs of human society, providing mobility and facilitating industry and trade" (Eurostat, 2013, p. 95). Access to transportation can improve living standards, increase safety and add to economic efficiency. However, the increasing numbers of people moving in and out of communities in individual vehicles has resulted in increased congestion leading to longer commute times and more air pollution from an increase in GHG emissions. The CIW Environment Domain report found that emissions produced from transportation specifically have increased 33% between 1990 and 2008 and fossil fuel industries have increased GHG emissions by 55% (Morgan, 2011).

Policy makers at the local level are always looking for innovative ways to deal with transportation problems. There is a need for sustainable transportation systems and the development of indicators and monitoring systems that track the way the people move in and around cities and towns. There is a need to monitor travel behaviour and view the infrastructure and energy used for transportation as being part of an important system. Aside from passenger vehicle use, there are additional important environmental pressures associated with transportation to consider. There are natural resources that are consumed during the production of oil and gas for transportation as well as the resources used for road and highway construction and the manufacturing of vehicles. Freight transportation can be regarded as a private sector issue; however, transportation used for commercial use creates the same pressures on the environment as passenger transportation does. In addition to emissions, chemical waste from roadways threatens water streams and habitat disruption is at risk from new road construction.

There are several different drivers associated with the transportation system in Canada. Both economic and social factors contribute to the growth of the transportation system and are critical to the growth of a community or region. Transportation is linked to social inclusion by providing citizens access to education and labour markets leading to a better educated and skilled population. Access to transportation allows Canadians to create and maintain social and familial relationships, encourages greater community inclusiveness and leads to stronger social, community and cultural growth. Transportation is also linked to human health, in that it provides access to health care and access to hospitals and long-term care facilities, which is becoming more important as the population ages.

The sheer size of Canada means that Canadians spend a lot of time, money and energy travelling. Canadians do most of their travelling within their home provinces. There were 188 million in-province visits and 19.6 million visits between provinces and Statistics Canada attributes the majority of this domestic travel to visiting friends and relatives (Statistics Canada, 2009). Tourism is also an important economic driver in many areas in Canada such as Whistler, B.C. and Niagara Falls Ontario. These areas are dependent on reliable transportation systems to bring tourists into the area in order to develop the local economy. The time, cost and energy that is involved in domestic travel within Canada can easily exceed the time and cost involved in international travel. The Canadian climate plays an important role in the country's use of energy for transportation. Transportation to destinations outside of the country has social and cultural importance to Canadians looking to get away from cold snowy winters to warmer destinations in the south. Travel and tourism to the southern United States and Caribbean locations are a profitable industry in Canada with Canadian airlines and cruise ships realizing most of their profits in the winter and spring months. In 2007 Canadians took more than 25 million overnight trips abroad (Statistics Canada, 2009).

Globalization is one of the leading drivers behind the use of transportation systems for both passenger and freight travel. The increasing demand for off shore products drives the movement of goods like food and clothing and this has resulted in an increase in commercial freight. Every mode of transportation (air, sea, road) used for passenger transport is also used for freight transport and both passenger and freight are important elements of any transportation system. Regional and urban planners sometimes focus on environmental indicators relating to the effects of passenger

transportation although freight transportation is an important contributor to the generation of waste and emissions. The prices associated with different modes of transportation also influence demand and growth in demand has a direct impact on energy consumption which contributes to the impact of GHG emissions and other air pollutants (Eurostat, 2013). The consumption of energy by the transportation sector is largely linked to issues of energy security and the production of non-renewables and biofuels.

Transportation presents obvious links to several domains within the CIW, the most obvious and important of which is the environmental domain and its impact is largely perceived as having been negative. The construction of transportation infrastructure can have harmful effects on biodiversity and habitat loss through land use changes. Air pollution caused by increases in GHG emissions affects human health as well as plant and animal health. Increases in traffic congestion leads to noise pollution affecting both humans and wildlife. In Europe, an increase in airport traffic has caused negative effects on the nesting behaviour of bird species (Eurostat, 2013, p. 97). Like the food system, transportation is largely affected by Canadian living standards and is seen to be essential to Canadian cultural identity. It is linked to our economic, social and cultural wellbeing but it may be at the cost of environmental wellbeing. The transportation system must be strategically monitored and analyzed to provide a better scenario for future generations. Identifying the most important drivers behind transportation will allow decision makers to improve upon an existing system and plan for future populations.

5.8.2 Impacts of a Transportation System on the Environment

Three important considerations in transport indicator development are transportation volume, energy consumption and greenhouse gas emissions. The European Union Sustainable Development Strategy (EU SDS) has examined the sustainability of the transportation system from the perspective of energy consumption and looks at decoupling transport volumes and transport energy consumption from economic development. The EU SDS, suggests transportation is one of the most challenging sectors to address because the transport system provides essential economic and social benefits yet contributes to high social and environmental costs (Eurostat, 2013). In 2001 the European Commission proposed a "shift in transport use from road to rail, water and public passenger transport so that the share of road transport in 2010 is no greater than 1998" (Eurostat,

2013, p. 102). The Eurostat headline indicator for Sustainable Transportation is Energy Demand of Transport. The energy demand indicator shows the ratio of energy consumption per unit GDP and showed only moderate decreases between 2000 and 2007 in the EU-27 with air and road transport showing increases in energy consumption (Eurostat, 2013, p.94). The volume of transport and mobility indicators showed that the road continues to dominant freight transport and freight transport is still growing faster than GDP, whereas passenger transport is growing at a lower rate (Eurostat, 2013, p. 94). In terms of waste and emissions, Eurostat indicators show that Greenhouse Gas Emissions from transport are increasing, but not as fast as the growth rate of total energy consumption for transport, and road transport contributed to 94% of the total transport GHG emissions in 2007 in the EU-27 (Eurostat, 2013, p.94). Europe has done an exceptional job at recognizing the importance of transportation systems for wellbeing and sustainable development. Moving between countries has become more and more efficient and people have adapted to a multi-modal transportation lifestyle.

In the year 2000, the Centre for Sustainable Transportation created a set of worldwide transportation indicators that had been developed by the Canadian National and Ontario Round Tables on Environment and the Economy, the Victoria Transport Policy Institute, the OECD, the World Bank and the United Kingdom. Included were transport behavior indicators, which could be paired with direct or indirect environmental pressure indicators. The drivers behind transportation pressures include basic human needs such as safety but also include socio-economic drivers such as urban density, level of economic activity, transportation activity and national and local policies (Gilbert & Tanguay, 2000). Other drivers include the state of transportation technology and the different modes of transportation available in a given area. Pressures can also be associated with the construction of transportation infrastructure, and the use and maintenance of modes of transportation both public and private.

5.8.3 Canadian Transportation

One third of Canadians live within a 160-mile radius of the Greater Toronto area and the population growth rate is the fastest for any metropolitan region in North America (Golden, 2014). The area is of significant size and is considered the fastest moving. Until recently, Toronto had been considered a leader in the development of efficient transit systems; however currently Toronto has become one of the worst performers in Canada for moving people to and from work

(Golden, 2014). Metrolinx was created in the greater Toronto and Hamilton area in 2006 as a response to the region's growing demand for a better transit system. The Greater Toronto Transportation Authority's goals are to improve the GO Transit system for regional transportation, create a universal fare for all transit modes, develop an investment strategy and implement "The Big Move", a 25 year, $50 billion regional transit plan (Golden, 2014). There are also plans to expand the current subway system, which has caused criticism due to perceived low ridership and the inability to justify costs relative to the number of jobs that would be created (Golden, 2014). Although people want an efficient, cost effective transportation system, the amount of economic resources that need to be devoted to improving it may not be justifiable. What is needed is a long-term strategy that examines elements of the system that can, should or must be improved balanced against the costs of those improvements in terms of economic development and environmental damage.

One of the biggest challenges facing the development of the ideal cost effective, efficient and environmentally friendly transportation system is the lack of coordination among the federal, provincial and regional governments. Metrolinx covers 30 local and regional municipalities, but there is no over-arching regional political governance (Golden, 2014). To increase accountability and legitimacy in the transportation sector, there is a need to better understand the transportation system from various angles and within an identifiable universal framework. The development of transportation policy can overlap many different areas of interest and involve several different players, making the policy area hard to identify. Often policy associated with transportation is linked with issues like climate change. Transportation is considered to be an old Canadian policy area, going back to Canadian confederation, whereas climate change policy is relatively new in Canada. Newman, et al., (2013) explains that transportation and climate change operate under two significantly different policy paradigms and this can result in chaos and confusion.

Many provinces in Canada have not changed the way they develop transportation policy in decades. British Columbia's and Ontario's transportation ministries are organized into similar policy domains which haven't changed for the past 50 years (Newman et al., 2013). These policy domains are highways, trucking, public transit, rail, inland waterways and rural airports. New climate change goals in BC and Ontario however may begin to serve as a stimulus to how transportation policy is developed in the future.

Policy resources in the Ministries of Transportation of BC and Ontario have not matched these ministries' expanding mandates in recent years. Despite significant political emphasis on the importance of climate action, these two provincial governments have not increased the resources that would be required for effective policy capacity in this area (Newman, et al., 2013, p.33).

The Canadian Index of Wellbeing could provide insight for the Ministries of Transportation in Canada with the missing resources / data to create new policy mandates. The Canadian Index of Wellbeing Environment Domain does currently measure GHG emissions from transportation specifically. Improving public transit is a start, yet understanding the transportation system as a whole can improve the way energy is used, help Canadians to become more efficient with their choice of transport modes and may reduce the effects of transportation on the environment. The development of transportation indicators in the CIW can help policy makers to understand the implications associated with sustainable transit systems and how these challenges can be overcome to lessen dependency on fossil fuels while continuing to keep society and the economy moving in the right direction.

5.8.4 Proposed Transportation Indicators for the Environment Domain

It is difficult to develop indicators that measure the transportation system of a nation or even a local community because of the transboundary nature of transportation and the different levels of government involved in its administration. For the purpose of the CIW, however domestic pressure indicators can provide useful information. The identification of important drivers and pressures on the environment from the transportation system must be identified. For the transportation system these include: how the use of natural resources puts pressure on the environment during the construction of roads and highways and the production of vehicles; the energy consumed during the production of specific modes of transportation and the impact of technology on choice of mode of transportation; the use of fossil fuels in the operation of various modes of transportation and the waste and emissions produced by mode of transportation and how current practices have resulted in irreversible land use changes during a period of expansion. In order to be effective, transportation indicators must

1. acknowledge environmental pressures (natural resource use, energy use, land use changes)
2. acknowledge production, infrastructure and outputs and the system as a whole (processing and transportation of food)
3. possess policy leverage points (relate to human activity)
4. be able to communicate important information to policy makers and the general public
5. be scalable on different levels
6. be linked to building healthy communities and other relevant social criteria and other indicators in the CIW.

With regards to food indicators I chose to only include biomass when measuring the materials flowing in and out of the system. For transportation the most apparent materials used are construction materials and fossil fuels. A stock and flow model is used to communicate the transportation system most effectively. The stock refers to vehicles or modes of transportation and the flows refers to the use of fossil fuels to operate the vehicles. Infrastructure is necessary for the stocks to flow in and out of the system requiring their own stock of materials and flows during construction. The materials for transportation include construction materials for infrastructure such as highways, bus terminals and airports. Fossil fuels are consumed during the production and use of vehicles.

Both consumers, producers and policy makers are interested in understanding how passengers and freight manage to get from one place to another and how selected modes of transportation place pressure on the environment. A useful set of indicators revealing the impact of the transportation system on the environment can be organized around the following:

Input

- Domestic Extraction
- Total imports of construction materials for transportation infrastructure
- Total imports of fossil fuels

Consumption

- Domestic fossil fuel consumption in the transportation sector per mode (Car, Train, Plane, Boat)
- Domestic construction material consumption for transportation sector
- Net additions to stock of fossil fuels and construction materials
- Physical trade balance of fossil fuels and construction materials for transportation

Output

- Domestic Processed output as a result of fossil fuel production / consumption
- Domestic Processed output of construction for transportation infrastructure
- Exports of construction materials for transportation infrastructure
- Exports of fossil fuels (in the form of crude oil for consumption in transport sector)

From a policy perspective overall objectives, operational objectives and targets can be developed from use of the indicators. The overall objective might be to improve resource efficiency and avoid the generation of waste within the transportation system. The operational objectives or targets might be to reduce by 5% per year the amount of fossil fuels used in personal vehicles driven in the province of Ontario until the year 2018. The actions/explanatory variables might be to reduce the amount of single passenger vehicles operating in the city of Waterloo by prohibiting the use of single passenger vehicles in certain areas of the city. Contextual indicators might involve the social, cultural and political role that vehicles have in the area. There might be a need to develop additional indicators such as those that measure the benefits of the use of public transport on human health, energy use, and land change. The development of effective indicators is an ongoing challenge. Consumer needs for specific types of vehicles are constantly changing and technology has the ability to improve modes of transportation so that the system becomes not only more efficient but kinder to the environment as well. The evolution of the Canadian transportation system to meet consumer needs puts constant pressure on the environment in terms of the use of natural resources, energy use, land use changes and waste. A key challenge in developing indicators to determine the impact of the transportation system on the environment is the number of different levels of government that are involved in the decision making about transportation. Canada is a large country and transportation is a critical system having important economic, social and cultural components. A key challenge for policy makers and the general public is to determine if the effect of such an extensive system is a reasonable tradeoff when the pressures on the environment are fully accounted for.

Food and transportation systems are important to Canadian livelihoods and present direct connections between wellbeing and the environment. Data availability and complexity have prevented these systems from becoming a part of the CIW in the past; however, by presenting food and transportation indicators using the DPSIR framework and MFA as a tool they become understandable and communicate a strong message about how these systems are affecting the Canadian environment. The data for MFA indicators are simple to access and the Canadian

government has already shown initiative to monitor the progression of both systems as new environmental management systems are implemented. This organizational model could be implemented for all indicators in the Environment Domain of the CIW showing the inputs, consumption patterns and outputs of human created systems and their affects on the environment. This presentation of indicators also allows for food and transportation systems to be connected to several other domains in the CIW including health and living standards and may prove useful to decision makers within the various levels of government.

5.9 Relevance to Canadian Policy Intervention

It is important to acknowledge government and non-government sectors that focus on the food and transportation systems. Food regulation and policy is addressed by Agriculture and Agri-Food Canada and Health Canada. In 2013, Health Canada in *Measuring the Food Environment* described food assessment methods, food availability and quality, geographic food access, community food systems and strategies for future research. It put value on food that is both nutritionally healthy, and environmentally sustainable (Health Canada, 2013). New system indicators have the potential to influence policy/decision makers in seeing the value in environmentally sustainable food and transportation systems and their relationship to wellbeing.

Transport Canada plans to release reports covering the period between 2013-2016 on the sustainable development strategy highlighting the trends in the environment, economy and society and the impacts on the natural environment. "The purpose of the Federal Sustainable Development Strategy is to provide a legal framework for developing and implementing a federal sustainability strategy that will make environmental decision-making more transparent and accountable to Parliament" (Transport Canada, 2015). Selected indicators include the scale of transportation activities, impacts of activities and responses to impacts (Transport Canada, 2015). Safety, security and environmental responsibility are the main priorities of Transport Canada and as of 2015, "respect for the environmental legacy of future generations of Canadians – guided by environmental assessment and planning processes in transportation decisions and selective use of regulation and government funding" (Transport Canada, 2015).

Decision making about food and transportation systems happen at all levels of government; cities, regions and provinces are all responsible for working together to make sure that there is a certain level of high quality and abundant food for Canadians in order to improve health and reflect living standards. Efficient transportation systems are needed to move Canadians around safely and efficiently and to reduce the time spent commuting and increase the time available to spend within communities and with families. The complexity of the decision making process at all levels of government requires an indicator model that can organize and present the environmental pressures on the environment in a way that can be related to current issues and policy agendas.

5.10 Conclusion

This chapter has shown the importance of understanding environmental pressures and how they are driven. The DPSIR model is an accounting framework that envelops the idea of environmental pressures into an understandable loop. It creates a system view from drivers to response and gives the system purpose and a chance to see where changes can be made in order to lessen the pressures placed on the environment from human activity. A good understanding of the DPSIR loop is important for a solid understanding of MFA. MFA can be described as a tool for the DPSIR system loop; both are loops that coincide. MFA indicators have been tried and tested in international indicator systems and have been shown to produce accurate and important information for policy and decision makers by addressing the links between inputs and outputs from human activity. DPSIR and MFA go hand in hand to support the understanding of the relationship between human activity and the natural envrionment; this connection is important for the Canadian Index of Wellbeing because these links can provide that snapshot of the differences between increased and decrease in human wellbeing. Both DPSIR and MFA can be used as an accounting framework and tool respectively in other domains of the CIW, by taking the explanation and research one step further and still keeping the communicativeness and understandability to reach out to the general public.

Chapter 6 Conclusion

An in depth literature review of the development of wellbeing indices, interviews with key informants involved in the development of indices, an analysis of international reports concerned with indicator development and referrals to models of systems thinking such as the DPSIR framework and Material Flows Analysis formed the basis for this thesis. As a result of this investigation, recommendations can be made to help improve the Environment Domain of the Canadian Index of Wellbeing in an effort to make it more relevant and useful for policy makers concerned with improving wellbeing. These contributions are summarized in this chapter, along with limitations, future research suggestions and concluding thoughts.

6.1 Practical Application of the Environment Domain of the Canadian Index of Wellbeing: Policy Leverage

The interviews with key informants did not provide enough information required to answer my research question: How can the Environment Domain of the Canadian Index of Wellbeing contribute to an understanding of wellbeing and communicate strategies that promote strategic sustainable development? It was not that the interviewees were reluctant to answer the question or had information that they refused to provide. It was more likely the result of the ambition and the complexity of the question. For many of the interviewees, the development of an index of Canadian wellbeing that adequately and effectively considered the environment in a way that could affect policymaking may be an unattainable goal. It is a goal that is worth pursuing however despite the fact that we may be a long way away from achieving it. Key informants involved in developing the CIW as well as other well-known wellbeing indices emphasized the specific obstacles and limitations associated with measuring wellbeing in a practical sense. Although there is an abundance of literature on the relationship between the natural environment and human wellbeing, there appears to be little in the way of practical ways of increasing wellbeing without jeopardizing the sustainability of the environment. Academics, the general public and policy makers are all interested in preserving, enhancing and improving the human – environment relationship and yet there are still debates about how to go about doing it. From the interviews it became clear that

because the topic was so immense and so important, that the best approach at this time was to emphasize the need for practicality and the use of simple, yet proven tools in the development of a practical framework. This would allow for better communicativeness of the index results and the applicability of this information for Canadian policy interventions.

Alexis Morgan was the most important participant in this study because of his specific involvement with the Environment Domain and his personal recommendations based on his experiences and the challenges he faced. He acknowledged the need for a closer more specific examination of human pressures on the environment as well as the need to take a systems approach to the problem. If drivers and pressures on systems such as food and transportation can be identified, the CIW can be improved by focusing on the impacts of these drivers and pressures both on the biophysical environment and also from the perspective on human health. Using a DPSIR approach, information collected within the environment domain can provide policy makers with an effective approach for addressing the relationship between human wellbeing, choice and the environment. Linking the environment domain to financial or economic considerations has not worked to the advantage of the environment. The policy response has been limited when environmental problems are directly linked to economic production because of the value placed on financial security. Environmental conservation and protection is perceived to be very costly in times of perceived limited financial resources.

From a policy perspective there may be something to be said about linking environmental problems to a decline in public health. Health is considered to be one of Canada's most important public sectors (if not the most important). The most robust and most easily accessible data gathered by the CIW exists in the Health Domain. The health of citizens is of primary importance to Canadian policy makers and considerable time, resources and money are allocated to the health care system. Here, we see a direct connection between policy value and the abundance of data in the CIW. The World Health Organization's Commission on the "Social Determinants of Health" concluded that health interventions should start to look outside the field of health and one of those fields could easily be the environment. The Region of Peel created a Healthy Development Index in 2009 to "provide a systematic method for public health staff to inform planning decisions" and many of the indicators developed are directly in line with common bottom-up environmental

initiatives. The indicators (which focus on urban design and transportation) include density, service proximity, land use mix, street connectivity, streetscape characteristics and parking.

The most common health problems affecting Canadians are obesity, arthritis, diabetes, asthma, high blood pressure and heart disease (Statistics Canada, 2014b). Many of these problems are linked to age and genetics, but often they are addressed with behavioral change. The environment is linked to health on many different levels. Many of the problems that people encounter with health and wellbeing can be either directly or indirectly related to their relationship with the physical environment, how often they connect to it, the quality of the natural resources within the environment and what uses these resources are put to and what people are willing and able to do to protect these resources. Many countries, including Canada have been moving towards a prevention versus treatment strategy to improve the health of citizens before they require health care services. Tilman and Clark's article "Global Diets Link Environmental Sustainability and Human Health" (2014) reveal that there is a diet, environment, health "trilemma" involved in the dietary choices of people around the globe. Using lifecycle analyses in the examination of 120 studies involving GHG emissions, waste, land use and human health problems like diabetes, cancer and heart disease, the authors were able to demonstrate that dietary change could have an important role in determining human health as well as health of the environment (Tilman & Clark, 2014).

Research on the human relationship with the environment consistently reveals that a healthy environment improves wellbeing. "Environmentally friendly" actions are directly associated with attitudes towards the environment and how much it is valued. A 2011 study from the University of Waterloo connecting climate change to health found that many people in the Golden Horseshoe Region of Southern Ontario who were willing to act in an environmentally friendly way (reducing, reusing and recycling) did not associate these behaviours with health benefits (Cardwell, 2013). The authors of the study concluded that there should be more effort made to reframe climate change from an environmental issue to a public health issue (Cardwell, 2013).

6.2 Limitations

The limitations of this study center around the ever evolving nature of the research topic, early methodological choices and the complexity of the recommended organizational tools. There was a lack of current academic literature, particularly in North America, concerning the development and application of wellbeing indices. Much of the applicable developments have been carried out in Europe. Although the theoretical literature surrounding wellbeing and quality of life is substantial, wellbeing indices and their application are a relatively new area of academic research.

Other potential limitations stem from the methodological choices made during the early stages of this research. The assumptions taken from the literature influenced the choice to conduct qualitative interviews of large-scale wellbeing indices similar to the CIW. Indices such as the HDI, GPI and ANDI had several researchers, professionals and organizations working on developing them over a considerable period of time. Many were involved with specific aspects of the project and for only a limited amount of time. It was difficult to identify individuals who could serve as key informants who had an overall grasp or perspective on the development of an index from its conception, to development to application. It was also difficult to find key informants who had knowledge of other indices, which would have been useful from a comparative perspective. Each index examined had similar limitations as well as obstacles specific to their project making it impossible to compare any to the CIW. Other limitations included the lack of available participants due lack of interest in participating indicated by the lack of response to the introductory email that served as an invitation to the study. Even if there was interest, availability to participate may have been hampered by time or geographic constraints. Many of the prospective key informants resided in other countries making it more difficult to solicit participation. Given more time or resources, more participants could have been involved in the research.

Another limitation to this study was the amount of time that could be devoted to applying both the DPSIR and Material Flows Analysis models to the organizational structure of the CIW. According to Tscherning et al., (2012, p.104) "…indicators classified according to the DPSIR framework should enhance communication between scientists, politicans and the public about environmental developments and issues" Understanding and being able to apply MFA indicators requires much more time than the length of this thesis could accommodate. For the purpose of the Environment Domain of the CIW, an overview of both DPSIR and MFA was provided in order to

introduce the need for a broader, more inclusive approach to integrating environmental considerations into the CIW. This researcher acknowledges the difficulty of developing appropriate and useful measures of wellbeing that consider the environment in all its complexity and acknowledges the need for further research in order to fully explore and develop the relationship between human wellbeing and environmental indicators.

6.3 Areas for Future Research

This thesis has examined several areas for future research based on the research question, interview results, realized limitations of the CIW and potentially emergent concepts. It focused on one domain of the CIW, however further research is needed for the development of an organizational structure which includes all domains within the CIW. This could provide the framework that is needed in order to explore the links between specific human activities and environmental depletion. A more holistic and integrative approach is needed to establish future indicator sets. It was also established that there is a lack of consistently available environmental data sources at the federal, provincial and regional levels. Research into indicator sets is abundant however, the ability to link indicator sets in any domain of the CIW requires trial and error and the support of monitoring programs to produce reliable and consistent set of data for the purpose of human wellbeing research. Two new indicator categories were proposed to supplement the current indicators within the Environment Domain. These new areas of interest, along with any potential others could form the basis of future research to create a more robust set of indicators and domains for use in the CIW. Examining specific systems such as Food and Transportation can enlarge our understanding of the variety of inputs, outputs and flows that are part of any system of production and consumption.

From a policy perspective, this is very much a "two birds with one stone" scenario. Attempts have been made to apply the CIW at both the provincial and community level. Some headway has been made, but because the framework is not easily adaptable, the results generally mirrored those that were achieved at the national level. The Ontario Index was able to show comparisons between national and provincial results and community surveys have been able to gauge personal preferences and behaviours when it comes to wellbeing. Community based versions of the CIW can be useful for smaller communities when they have to determine the value

of different upcoming projects (for example more dog parks vs. a river clean up). Unfortunately, there has been little or no acknowledgement of the role that the CIW can play as a credible, reliable and long-term monitoring tool in the Region of Waterloo. The two regional planners who were interviewed for this study had an understanding of, and interest in environmental issues and were involved in local environmental projects but neither had any idea of how the CIW could be helpful to them in the development of those plans.

Ecological Footprint, one of the indicators in the current environment domain, mentioned in section 5.1 should be analyzed further. Given the recommendations in this thesis and the acknowledgement that the ecological footprint uses a systemic approach to measuring humans' impact on the environment, it is important to keep this indicator in the environment domain. Further research and analysis is required to compare DPSIR and MFA models with the ecological footprint. It is also important to acknowledge the CIW framework compiling 8 indicators within 8 domains. It was found in the participant interviews, that keeping a consistent number of indicators and domains was important for the consistency of the CIW. This study has recommended more than 8 indicators for the environment domain and further research is required to select a 'top 8'. This selection is dependent current monitoring practices and available data of the recommended indicators.

The interview results were not as conclusive as I had hoped, although they did provide some insight into the need for more research into the topic and pointed out the limitations involved in conducting research in the field of wellbeing indices. During the discussions surrounding the purpose of wellbeing indices, each participant was supportive about the need for including some aspect of the environment in any measurement of human wellbeing. If measured strategically and holistically, with an appropriate organizational structure and bountiful and comparable data sources, indices like the CIW could go a long way to addressing current environmental problems.

6.4 Concluding Thoughts

Because there will always be controversy determining what elements constitute wellbeing, providing a general snapshot of wellbeing has its merits. It provides people, academics and planners with a starting point to start debating and determining what they value and how to measure

it. Wellbeing indicator research is inexplicably part of a larger theoretical issue about society and the way it develops. Communication is the most important function of the development of wellbeing indicators. Throughout the process of conducting this study, it has become apparent that developing environmental indicators that can be related to wellbeing is an extremely complex task. It is also apparent that the relationships between the human system and environmental system cannot be sufficiently explained through the use of a simple framework. From a policy perspective, there is a need for clear and precise information on the driving forces that result in environmental pressures, which result in changes in the state of aspects of the environment that are important for human wellbeing. The impacts that result from those environmental changes are the ones that need to be closely monitored because those are the ones which are most likely to trigger societal response especially in the area of policymaking. Communicating environmental concerns with the intent of influencing policy requires that those in key roles are able to fully understand the issues and are able to address them in strategic and productive ways. In addition, providing information on driving forces, impacts and policy responses, environmental indicators can be powerful tools used to raise public awareness on environmental issues.

In summary, the Environmental Domain in the CIW could be made more relevant for decision making by:

- Actively advocating for better monitoring of the environment through participation in intergovernmental, public education and media related activities.
- Actively advocating for better quality and availability of environment data through participation in intergovernmental, public education and media related activities.
- Examining the drivers underlying environmental pressures.
- Taking a systems approach to examining environmental states and impacts.
- Examining the food and transportation systems.
- Moving beyond Canada to see how indicators are developed and applied in other countries and learning from previous attempts at developing effective and reliable indicators.
- Collecting and integrating subjective data (people's perceptions of air quality, availability of quality food) and using this information for educational purposes.
- Exploring and emphasizing the relationship between indicators of health and the environment.

The purpose of this thesis was to show how the environment domain in the CIW could be developed to effectively communicate information that would be useful for policy makers interested in enhancing the wellbeing of Canadians. Both the DPSIR framework and Material

Flows Analysis provide useful perspectives to help policy makers better understand the meaning of the information derived from various types of indicators. The better able the indicators in the environment domain are in communicating issues, alternatives and strategies, the more useful they can be in developing effective sustainability strategies and enhancing the long-term wellbeing of Canadians.

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Appendices

Appendix A Participant Information

Name/ Website	Title	Date of Interview	Where	Length of Interview	Reference
Pierre Filion uwaterloo.ca/planning/people-profiles/pierre-filion	Planning Professor UW	September 17th 2014	In-person	43 minutes	Personal
Alex Michalos uwaterloo.ca/canadian-index-wellbeing/about-canadian-index-wellbeing/foundational-leaders	Quality of Life, Wellbeing Research, University Professor, 2nd Director of research at CIW	September 30th, 2014	Phone	45 minutes	Personal
Kevin Eby	Director of Community Planning for the Region of Waterloo	October 15th, 2014	In-person	1 hour 45 minutes	Pierre Filion
Mike Salvaris www.andi.org.au/about/board	Professional Research Fellow, Australian National Development Index	October 22nd, 2014	Skype	2 hours	Canadian Index of Wellbeing
John Talberth sustainable-economy.org/about-us/dr-john-talberth-president-and-senior-economist/	President and Senior Economist at the Centre for Sustainable Economy, GPI, Ecological Footprint	October 27th, 2014	Skype	47 minutes	Canadian Index of Wellbeing
Alexis Morgan www.sfu.ca/content/sfu/continuing-studies/instructors/m-p/alexis-morgan.html	Lead author of CIW Environment Domain, Conservation & Sustainability researcher, Instructor	October 29th, 2014	Skype	1 hour 15 minutes	Alex Michalos
Mark Anielski www.anielski.com	Author of Economics of Happiness, Genuine Wealth	November 14th, 2014	Phone	34 minutes	Canadian Index of Wellbeing
John De Graaf neweconomy.net/people/john-de-graaf	Author, Filmmaker "Take Back Your Time" "The Happiness Initative", Advisor for Gross National Happiness	December 9th, 2014	Skype	38 minutes	Advisor Contact

Appendix B Cover Letter Email

University of Waterloo

(Date)

Dear (Participant's Name)

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the School of Environment, Enterprise and Development at the University of Waterloo under the supervision of Professor Simron Singh. I would like to provide you will more information about this project and what your involvement would entail if you decide to take part.

There are several ways of conceptualizing, describing and measuring sustainability. By looking beyond the measurement of Gross Domestic Product (GDP), wellbeing indices were designed to emphasize the need to develop more inclusive, equitable and balanced approaches to measuring wellbeing and sustainability. Policymakers are paying increasing attention to the idea that broader measures than the GDP should guide their decision-making and a number of wellbeing indices have been developed, however, the role of the environment in these indices has been slow to evolve. The purpose of this study is to gain an understanding of the relationships between human wellbeing, the biophysical environment and sustainability.

This study will focus on the Canadian Index of Wellbeing, specifically the indicators they use to measure environmental impact. I will be looking at how the indicators in the Canadian Index of Wellbeing can be improved to become relevant for planners making important decisions that effect the environment and the wellbeing of Canadians. The development of appropriate environmental indicators is essential for the development of successful sustainability. Therefore, I would like to include you (your organization) as one of the participants in my study. I believe that because you are actively involved in (Canadian Index of Wellbeing, Planning Sector, Wellbeing Index, Environment, Sustainable Development) you are best suited to speak on the various issues, such as how sustainability effects city/regional planning, how our wellbeing is effected by environmental changes and how the overall wellbeing of communities is extremely important to acknowledge.

Participation in this study is voluntary. It will involve an interview of approximately 1 hour in length to take place in a mutually agreed upon location. If we are unable to meet in person a telephone interview will be conducted and the consent form may be faxed or scanned. You may decline to answer any of the interview questions if you so wish. Further you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis. Shortly after the interview has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish. All information you provide is considered confidential with the exception of your permission. Data collected during this study will be retained for 1 year in my supervisors' locked office. Only researchers associated with this project will have access.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at 519-568-9973 or by email at ae2graha@uwaterloo.ca. You can also contact my supervisor, Professor Simron Singh at 519-888-4567 ext. 33111 or email simron.singh@uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact the Office of Research Ethics at 519-888-4567 ext. 36005.

I very much look forward to speaking with you and thank you in advance for your assistance in this project.

Yours Truly,

Allison Graham

Appendix C Consent Form

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

_____

I have read the information presented in the information letter about a study being conducted by Allison Graham of the School of Environment, Enterprise & Development at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through a University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 519-888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

I agree to have my interview audio recorded.

☐YES ☐NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

☐YES ☐NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

Appendix D Participant Feedback Letter

University of Waterloo

Date

Dear (Participant Name)

I would like to thank you for your participation in this study entitled "The Relationship Between the Environment, Sustainability and Wellbeing Conceptualized in the Canadian Index of Well-Being". As a reminder, the purpose of this study is to understand the relationship between human wellbeing and the natural environment in order to improve the indicators used in the Canadian Index of Well-being.

The data collected during interviews will contribute to a better understanding of how human wellbeing and the natural environment effect one another and how this can benefit sustainable policy initiatives.

Please remember that any data pertaining to you as an individual participant will be kept confidential. Once all the data is collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations and journal articles. I will also be sharing the information collected with the Canadian Index of Wellbeing. If you are interested in receiving more information regarding the results of this study, or would like a summary of the results, please provide your email address, and when the study is completed, anticipated by (April 2015), I will send you the information. In the meantime, if you have any questions about the study, please do not hesitate to contact me by email or phone as noted below. As with all University of Waterloo projects involving human participants, this project was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 519-888-4567, ext 36005 or maureen.nummelin@uwaterloo.ca.

Allison Graham

University of Waterloo

School of Environment, Enterprise & Development

ae2graha@uwaterloo.ca

Appendix E Alex Michalos & Alexis Morgan Interview Questions

Alex Micahelos September 30th 2014

Alexis Morgan October 29th, 2014

1) What is your background? Primary field of research?
2) How did you become involved in the Canadian Index of Wellbeing
3) What was your role in the CIW?
4) Was the CIW intended to improve policy and government decision-making? Or was it more to inform communities and make them more aware of the importance of wellbeing?
    a. Was it more about informing or applying?
    b. Composite index's are easier to understand, you gave many reasons why composite index's don't work
5) Why were the Environment domain and its indicators chosen for the CIW?
6) What was the largest obstacle the CIW faced during the development of the framework / methods for indicators?
7) Currently, do you think the CIW captures the environment domain well enough in order to link it to Canadian wellbeing?
8) How relevant was the environment domain compared to others?
    a. Was there more or less emphasis placed on some domains rather than others? For example: There is a large emphasis by the Canadian government to make health care statistics available, do you think this had an effect on the Health domain?
    b. Why or Why not?
9) In the 2011 CIW Technical Paper the "Mandala of Wellbeing" (Mandala of Health) is referenced and the environment encompasses all other domains, however the composite nature of the CIW weighs all domains the same and averages a single number. Do you think its possible to change this to reflect the initial intention?
10) There is evidence in the 2012 CIW Report that links the decline of the environment domain with health risks like respiratory disease and air pollution.
    a. Do you think if more links (relationships shown) like this were emphasized then more people would link the declines in wellbeing to the distress in the natural environment?
11) Do you think links between the environment and other domains are important?
12) What are your thoughts on the CIW being reduced in scale to Regional level?
    a. Do you think it would be more relevant at a smaller scale?

Appendix F Pierre Filion & Kevin Eby Interview Questions

Pierre Filion, September 17th 2014

Kevin Eby, October 15th, 2014

1) What is your field of focus as a planner, what type of planner are you?
2) Do you use indicators during the initial planning process (social, economic, environmental?
   a. Why do you use these
   b. Why don't you use these
3) Are you familiar with wellbeing indices?
4) Do you feel like integrative indices should be implemented into planning practices?
5) Have you heard of the Canadian Index of Wellbeing
6) Does the environment domain present a clear picture of how the environment is doing? Do you use the indicators in the current environment domain?
7) What would you change about the CIW to be more applicable to regional planning?
8) Do you think this approach of measuring societal progress will be more relevant in the future?
9) Do you think wellbeing indicators are necessary for sustainability planning? In particular, to better understand how human wellbeing is connected to the natural environment?
10) Do you have any experiences within your environmental planning profession where these indicators have been used?
11) Is there anyone you can recommend I speak with about this topic?

Appendix G Mike Salvaris Interview Questions

Mike Salvaris October 22nd 2014

1) What is your background? Primary field of research?
2) How did you become involved in the Australian National Development Index? What is your role?
3) Is ANDI intended to improve policy and government decision-making? Or was it more to inform communities and make them more aware of the importance of wellbeing?
   a. Was it more about informing or applying?
   b. Composite index's are easier to understand, although harder to apply
4) How does the ANDI define sustainable wellbeing?
5) Why were the Environment domain and its indicators chosen for ANDI
6) How relevant was the environment domain compared to others?
   a. Was there more or less emphasis placed on some domains rather than others?
7) What was the largest obstacle that ANDI faced during the development of the framework / methods for indicators?
   a. Specifically with aspects to relating wellbeing to the environment?
8) Currently, do you think the ANDI captures the environment domain well enough in order to link it to Australian wellbeing?
9) Do you think wellbeing indices like the ANDI and CIW can ever be used for substantial policy planning?
10) The Australian Treasury Working Paper says that successful indicators have to be based on both theory and practice
11) The CIW report (2012) showed declines and inclines in the different domains in the index, however the links between these are proving to be harder to show. Do you plan on (or do you) show the relationships and links between the 12 domains the ANDI measures?
12) Do you think showing the links between human wellbeing is important for making wellbeing indices applicable to policy decisions?
13) The CIW has been making efforts to scale the index to a smaller level in order to make it more relatable to specific communities. Do you think measuring national wellbeing is effective?

Appendix H John Talberth & Mark Anielski

October 27nd 2014

John Talberth

1) What is your background? Primary field of research?
2) Does the center for sustainable economy conduct any research on wellbeing? Theory or Practice of measuring wellbeing?
   a. How does it define wellbeing and its importance to redefining progress?
3) The GPI uses the word *Progress* rather than *Development or Wellbeing* as other indices of this nature do.
   a. How is progress defined?
   b. Is it adapted by the idea that we have to look at progress in a more integrative holistic sense? Or is it more an adapted GDP?
4) How does the Genuine Progress Indicator improve on the idea of progress → wellbeing → environmental sustainability
5) The methods chosen for your indicator analysis suggest you must acknowledge all levels of government (national, regional, community)
   a. Why is it important to do that?
   b. Should sustainable policy be measured differently at different levels of government?
6) Could you explain the *scenarios for sustainability*?
   a. How it impacts regional sustainability planning?
7) In your opinion what are the most effective sustainability indicators for measuring the intended idea of progress?
8) How relevant was the environment domain compared to others?
   a. Was there more or less emphasis placed on some domains rather than others?
9) What is the largest obstacle that the GPI faces with measuring economic, social and environmental realms together
   a. Ex. Is there more information/push towards one realm than the others?
   b. What is the hardest part for balancing these 3 important sectors
10) Has this method of measuring progress been adapted well into public policy?
    a. What are the barriers that are stopping it
11) Do you think these holistic/integrative approaches are realistic and can gain momentum in a global way?
12) Do you know of anyone I could speak with about these topics? Those who are working on measuring wellbeing/progress and its application to sustainability practices?

Mark Anielski November 14th, 2014

1) What is your background/primary field of research? How did you become involved with the CIW or wellbeing indices in general?
2) What brought you on to the environment domain of the CIW? What was your interest?
3) The CIW shows an interest in being a communicative decision making tool, but so far the domain has been more on the side of community information rather than policy information what is your opinion on that?
4) Do you believe it is important to include subjective data in environmental indicators?
5) Would the CIW be able to be applicable at a regional level like the Genuine Progress Indicator?

Appendix I John De Graaf Interview Questions

December 9th 2014

1) What is your background? How did you first become involved with measuring wellbeing?
2) Are you familiar with the Canadian Index of Wellbeing?

2) How would you explain the relationship between wellbeing and environmental sustainability?

- Are they intrinsically linked? We will be happier with a healthier planet / a healthier planet will lead to our happiness?

3) You have done some work with Gross National Happiness, and possibly implementing a similar system in North America. Is this possible?

4) What suggestions do you have for making this more relevant to policy makers/the government

5) Your work with the Centre for Humans and Nature discusses a lot of issues surrounding how we use our time… do you think it is possible to change the way people think? Where does the shift happen?

6) There are many different ways of measuring wellbeing? Can you suggest the most important way?

(ie Adapted GDP, Sustainability Models, National vs State)