The link between human health and sustainability

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Introduction

A little over a decade ago the United Nations commission garnered almost worldwide political consensus on the urgent need for sustainability. Various countries and institutions started to struggle with the same problem, the question was posed--what is sustainability, and specifically, what does it mean for a particular sector, nation, or region? (Goodland, 1995). This concept of sustainability encapsulates three major sectors of global productivity: environmental, economic and social. Overlaps exist among the three, and defining each component of sustainability distinctly may help organize the action required to approach global sustainability (Goodland, 1995). Sustainability also referred to as sustainable development can therefore be defined as "Improvement in the quality of human life within the carrying capacity of supporting ecosystems ... that meets the needs of the present without compromising the ability of future generations" as stated by the Brundtland Commission (Enger, 2008). The need for sustainability arose from the recognition that the profligate, extravagant, and inequitable nature of current patterns of development, when projected into the not-too-distant future, leads to biophysical impossibilities; we cannot grow into sustainability (Goodland, 1995). The long term good health of populations depends on the continued stability and functioning of the biosphere's ecological and physical systems, often referred to as life-support systems (World Health Organization--Geneva, 2003).

Environmental sustainability seeks to sustain global life support systems indefinitely. Source capacities of the global ecosystem provide raw materials such as food, water, air and energy, while sink capacities assimilate outputs or waste. Overuse of a capacity impairs its provision of life support services (Goodland, 1995). The notion of economic sustainability was firmly embodied in the writings of J. S. Mill and T. R. Malthus who both emphasized that the environment needs to be protected from unfettered growth if we are to preserve human welfare before diminishing returns set in. Economic sustainability revolves on consuming interest, rather than capital and can be defined as the amount of goods that can be consumed during a period, while remaining well off at the end of the period (Goodland and Daly, 1996; Goodland, 2002). Social sustainability is systematic. It involves human capital that invests in education, health, and nutrition of individuals and is now accepted as a part of economic development. Ultimately, there can be no social sustainability without environmental sustainability because environmental sustainability supplies the conditions for social sustainability (Goodland, 1995).

It is all too easy to overlook this dependency, particularly at a time when human species is becoming increasingly and distanced from these (World Health Organization--Geneva, 2003) life-support, integrated, sustainable systems. As a result of human induced impacts on these systems, the human species have now placed their lives on the line. Human health plays an integral role on human existence and development, therefore an omnipresent and undeniable link exist between human health and sustainability.

The last half-century has seen momentous and accelerating changes in humankind's economic activities, political relations and social and demographic profile. Urbanism and individualism within modern Western culture has diminished people's awareness of the dependence of continued good health on the natural world (McMichael et al, 1999). However, most changes to ecosystems have been made to meet a dramatic growth in the demand for food, water, timber, fiber and fuel (Health Synthesis, n.d.). Approximately 60% of the benefits that the global ecosystem provides to support life on earth are being degraded or used unsustainably (Health Synthesis, 2005). In the 30 years after 1950 and 150 years between 1700 and 1850, more land was converted to cropland. These cultivated systems cover 30% of the landscape and as a result has confined livestock production and freshwater aquaculture. In the last several

decades of the twentieth century 20% of the world's coral reefs were lost, while an additional 20% have been degraded. Since 1960 the amount of water impounded behind dams has quadrupled; water withdrawals from rivers and lakes have doubled since then, and most of the water is used for agriculture. Also since the 1960's, flows of reactive nitrogen in terrestrial ecosystems have doubled and flows of phosphorus has tripled. The atmospheric concentration of carbon dioxide has increased by about 32% since 1750 (from 280 ppm to 376 ppm in 2003), contributing to the global warming phenomena (Health Synthesis, n.d.). In the aggregate, and for most countries, changes made to the world's ecosystems in recent decades have provided substantial benefits. Unfortunately, human well-being is affected by changes in the composition, functioning and flow of ecosystem services. During the planning process these changes are not always taken into account and have had significant impacts on human health. Poor populations are more vulnerable to adverse health effects from both global and local changes. It is usually the richer populations that exert disproportionate pressure on global ecosystems but are less vulnerable. Many people and places affected by these changes are highly vulnerable and ill-equipped to cope with further losses. This vulnerability has increased as a result of the growth of populations in living ecosystems that are at greater risk from extreme weather or natural disasters. Historically, poor people disproportionately have lost access to ecosystem services as demand from wealthier populations has grown. (Health Synthesis, n.d.). Over 1 billion people survive on incomes of less than 1 USD per day, mostly in rural areas where they are highly dependant on agriculture, grazing and hunting for subsistence. Diminished human well-being tends to increase immediate dependence in ecosystem services (Health Synthesis, n.d.) and as a result additional pressure can damage the ecosystem's capacity to deliver essential services. Within and between countries, poverty is a consistent underlying determinant of undernutrition and diseases. Poverty and hunger have tended to force rural people onto marginal drought-prone lands with poor soil fertility, while others have been forced to move to urban slums. In Africa, Latin America and Asia, 25-50% of the population lives in informal or illegal settlements around urban centers with few or no public services and no effective regulation of pollution or ecosystem degradation (Health Synthesis, n.d.). The stark declines in life expectancy in countries of Central and Eastern Europe during the 1970's and 1980's, testify to the importance of broad social and economic influences on health (McMichael et al, 1999).

Thus far, the relationship between sustainability and human health has been established. However, in order to truly understand the severity and appreciate this delicate and important link that exists between human health and sustainability, four systematic impacts were studied; population, food shortage, natural disasters and climate change. These case studies reveal the direct, indirect and critical impacts of disturbed ecosystems on human health.

Case Study: Population

The United Nations estimates that by the middle of this century, the world population is likely to increase to more than nine billion people, which is equivalent to an extra 200, 000 people each day. This growth in population would put immense strains on the planet's life-support system (Connor, 2006). Overpopulation is indicative of a situation in which the population of a living species exceeds the carrying capacity of its ecological niche. In common parlance, the term usually refers to the relationship between the human population and its environment. The world's agricultural production and wealth is not evenly distributed resulting in poverty, where poor developing and under developed countries have large uncontrolled population growth. This uneven distribution combined with natural growth causes the population to grow to unsustainable levels. This unsustainably endemic to these poorer countries in the world directly results in famines and pandemic diseases. All population of organisms, including humans, is partially or completely limited by poor health. Human health dynamics are further complicated by the increased density of humans because high densities facilitate the increase and spread of infectious organisms among people (Pimentel et al, 1998). The Black Death, cholera, tuberculosis, and HIV are essentially problems of dense urban populations. Today, infectious diseases cause approximately 37% of all deaths worldwide.

In addition, more than 3 billion people suffer from malnutrition, and 4 million infants and children die each year from diarrhea, which is cause largely by contaminated water and food. According to current population growth trends, the world's population will double to 12 billion in the next fifty years (Pimentel et al, 1998), intensifying pollution and disease problems. Growth rate projections indicate that by 2025, two-thirds of the world's population will settle in large urban areas. Densely crowded urban environments, especially those without adequate sanitation, are of great public health concern because they are the sources of disease epidemics (Pimentel et al, 1998). Waterborne diseases account for 80% of all infections world wide and 90% of all infections in developing countries (Pimentel et al, 1998).

As people encroach onto natural ecosystems where land is cleared for exploitation and infrastructure development, soil becomes exposed and the chances increase of humans becoming infected by helminthes, such as hook worms, and pathogenic microbes' e.g. Escherichia coli. The spread of new strains of E. coli is due mainly in part to rapid human expansion in areas where humans are crowded and water and food contamination is rampant. Another rapidly increasing disease is AIDS, which is caused by HIV. The growth in human population has fostered the spread of HIV and AIDS (Pimentel at al, 1998). With this continued population growth, the rise of agriculture to meet the demand for food aids in the spread and virulence of infectious diseases worldwide. In developing countries where most of the growth is expected to occur, will seek to meet this demand, but poor public health infrastructure would put the global food supply at risk (Ellis, 2007).

The prevalence of human diseases is increasing rapidly throughout the world; so are the numbers of deaths. This rapid expansion of human populations is a major factor in the rise of human disease, which significantly impacts human health and development. In order to prevent disease, poverty, and malnutrition from worsening, the imbalance between population growth and the earth's resources must be dealt with. Comprehensive, fair population control policies combined with effective environmental management are required. Without international cooperative efforts, the quality of life for all human will diminish (Pimentel et al, 1998).

Case Study: Food Supply

Food supply is one of this world's major problem that directly impact human health. Closely associated with population growth, rapidly expanding human populations intensify the food supply problem by diminishing the per capita availability of cropland (Pimentel et al, 1998). However, it is the fact that lack of economic resources to purchase food, as well as political unrest and instability in regions where the overall food supply is inadequate, are the major causes interrupting food supplies (Pimentel et al, 1998). Therefore, the problem with this complacency is that conventional indicators of standard of living pertain to commodity production, not to the natural resource based on which all production depends (Daily et al, 1998).

There is serious concern in the health sectors about the crisis caused by soaring food prices and the impact it is having on poor and vulnerable populations. An estimated 3.5 million deaths occur each year as a result of malnutrition, and many more will die once this crisis continues (Chan, 2008). The World Health Organization (WHO) has identified 21 countries around the world which are experiencing high levels of acute and chronic undernutrition, while the Food and Agriculture Organization (FAO) reported that there are 40 countries facing food shortages world wide; the Darfur region of Sudan is the most pressing humanitarian problem today (Chan, 2008; Buerkle, 2006).

Food shortages generally occur due to a complex combination of factors, these include: Conflict and civil strife, economic and social change resulting in or aggravating poverty or leading to collapse of basic infrastructure and systems, poor governance, inequalities, as well as inappropriate land management and farming methods can contribute to both short and long term food shortages (WHO, 2005). Malnutrition is

the most prevalent public health problem in the world today, especially in developing countries. Malnutrition compromises natural immunity leading to increased susceptibility to infection, more frequent and prolonged episodes, and increased severity of disease. Severe malnutrition often masks symptoms and signs of infectious diseases making prompt clinical diagnosis and early treatment very difficult. Protein energy malnutrition (PEM) and micronutrients deficiency increase morbidity and mortality in infants and children (WHO, 2005). Today, more than 3 billion people suffer from malnutrition. In many parts of the world, especially in developing countries, severe shortages of vitamin A cause blindness and death. Similarly, iron intake per person has been declining during the past 10-30 years, especially in sub-Saharan Africa, South Asia and South America because of inadequate nutrition resulting from food shortages (Pimentel et al, 1998). An estimated 20% of malnutrition deaths can be attributed to anemia, while approximately 1.6 billion people live in iodine-deficient environments and suffer from iodine-deficiency diseases (Pimentel et al, 1998).

The WHO is doing all it can to help manage the health dimensions of this crisis (Chan, 2008). Close monitoring of the global food situation is being conducted in countries most affected by food shortage issues; Africa: Darfur, Somalia, Burkina Faso, Mali, Niger, Liberia, Sierra Leone and Zimbabwe; Asia: Korea, Nepal, India, China, Pakistan, Iraq, Afghanistan and Armenia; Central America: Guatemala, Haiti, Nicaragua and Honduras (Buerkle, 2006). However, it is the uneven distribution of global economies of scale that needs to monitored most. Donor countries would do Africa, Asia and Central America, as well as the rest of the world a lot of good if they focused less on shipping expensive food aid from Europe and the United States and focused much more on helping farmers gain access to the inputs they need for higher productivity (Altman, 2008). At the same time, the rich countries should stop diverting their food crops and their food-growing land for biofuel production (Altman, 2008).

Case Study: Natural Disasters

Natural disasters are catastrophic events of an atmospheric, geologic and hydrologic nature. These disasters include: earthquakes, floods, droughts, tsunamis, volcanic eruption and landslides. Natural disasters can have a rapid or slow onset, with serious health, social and economic consequences (Watson, Gayer and Connolly, 2007). The presence of large numbers of dead bodies in the disaster affected area heightens concerns of disease outbreaks. The risk for communicable disease transmission after disasters is associated primarily with the size of the population, the characteristics of the population displaced, their proximity to safe water, nutritional status and the level of immunity to vaccine-preventable diseases such as measles (Watson, Gayer and Connolly, 2007). Access to safe drinking water is jeopardized after the occurrence of a natural disaster. Diarrheal outbreaks result after drinking water has been contaminated, especially after a flood event. In Bangladesh in 2004 >17,000 cases were reported. Hepatitis A and E are also transmitted by the fecal route, in association with lack of access to safe water and sanitation. Leptospirosis, an epidemic zoonotic bacterial disease, can be transmitted by direct contact with contaminated water. Natural disasters, particularly meteorologic events such as cyclones, hurricanes and flooding, affect vector breeding sites and vector borne disease transmission (Watson, Gayer and Connolly, 2007). Usually disaster victims die of trauma, burns or drowning, and are no more likely than the local population to have acute infections or rare diseases (Morgan, 2004). The relationship between natural disasters and communicable diseases is misconstrued. The fear of the risk of outbreaks is derived from the perceived association between dead bodies and epidemics. However, as mentioned the risk of outbreaks after natural disasters is primarily associated with population displacement, availability of safe water and sanitation, as well as the availability of services. The effect of natural disaster is however great, because it is exacerbated by issues surrounding population, economy and the general well being of the country affected. Therefore, to compound the issues surrounding human health, poor developing countries, which carry the majority of the world's population and less of its wealth are always most affected, and prone to natural disaster related epidemics.

Risk management and impact assessment of regions prone to natural disaster is essential in combating the human health issues that arise. Surveillance in areas affected by disasters is fundamental to understanding the impacts of natural disasters on communicable diseases illnesses and deaths ((Watson, Gayer and Connolly, 2007).

Case Study: Climate Change

There is now widespread consensus that the earth is warming at an unprecedented rate. Stresses on the climate system are causing impacts on the earth's surface (McMichael et al, 2003). The world's climate system is an integral part of this complex of life-supporting processes, one of many large natural systems that are now coming under pressure from the increasing weight of human numbers and economic activities.Increasing the concentration of energy-trapping gases in the lower atmosphere, human actions have begun to amplify Earth's natural greenhouse effect. Global climate change is a significant addition to the spectrum of environmental health hazards faced by humankind (McMichael et al, 2003). Global climate change would affect human health via pathways of varying complexity, scale and directness and with different timing. Climate can be affected by any factor that alters the radiation balance or the redistribution of heat energy by the atmosphere or oceans. Anthropogenic forcing results from the gases and aerosols produced by fossil fuel burning and other greenhouse gas emission sources, and from alterations in Earth's surface from various changes in land use. Increases in the concentrations of greenhouse gases will increase the amount of heat in the atmosphere. Carbon dioxide currently contributes the largest portion of anthropogenic emissions. Other emissions include nitrous oxide, PCB's, dioxins and methane. The phenomenon of global climate change is better referred to as global warming (WHO, 2003).

Global warming as defined by The Encyclopedia of Earth 'refers to the documented historical warming of the Earth's surface based upon worldwide temperature records that have been maintained by humans since the 1880s. The emissions of 'green house gases' by man, has caused the world's temperature to be on an incline (McMichael et al, 2003). According to Pollution Probe's document entitled 'Climate Change and Human health', the Earth's temperature has been rising by almost one degree since the 19th century, with the 1990s proving to be one of the warmest decades of the millennium. Over the next century, it has been estimated that the change in the average temperature of the Earth can be anywhere between 1.4 C to 5.8C (McMichael et al, 2003). With the rise of the Earth's temperature, concerns have been rising over the effects of these changes on human health.

Directly, the increase of heat can kill a human by going beyond the body's capability to cool its self. In 1995, Chicago was hit with a heat wave that took the likes of over 500 people and caused thousands of emergencies across the state. Meanwhile, 8 years later, The World Health Organization (2003) blamed close to 20,000 deaths on the heat wave that seemed to have taken over Europe. Just the heat alone can cause illnesses such as heat cramps, heat strokes, and fainting. With the combination of pollutions, the increase in heat can cause sever cardiovascular and pulmonary conditions, which can prove to be fatal (McMicheal et al, 2003). The stronger presence of UV radiation can cause a host of health problems for the human population. According to the WHO (2003) report, the concentration of ozone has been depleted any where from 4 to 7 percent over a given area during the 1980s and 1990s. When UV radiation makes contact with the skin, it can cause several diseases such as malignant and non melanocytic skin cancer and photodermatoses. The eyes are affected even further due to their sensitivity that can result in a condition called photoconjunctivits, cancer of the cornea, and macular degeneration. While most of these can cause a severe degradation of the quality of a person's life, some of these diseases can eventually lead to death (McMichael et al, 2003).

As the increase of the world's temperature continues, numbers of extreme naturally occurring weather conditions have also increased. The effects of these events, (storms, floods, and droughts) can cause the

death and suffering of millions if not billions of people. El Nino and La Nina are two phenomenons' that cause droughts and flooding across the world (WHO, 2003). As the population of the planet continues to rise, the amount of food available is becoming scarce. Droughts and floods destroy crops, making it even harder to keep up with the demand for adequate food, leaving many countries to deal with food shortages; once again the poor developing countries are greater risks. In turn, those who are unable to pay for the rise in food prices or countries that are unable to pay for the import of food, will either have to depend on the hope of aid or be forced to deal with famine (McMichael et al, 2003). Along with the destruction of crops, flooding can also cause an increase of diseases resulting in illnesses and death. When flooding occurs, water can come into contact with contaminated soil and vector sites and thus the water becomes contaminated as well. That water will eventually make its way to non contaminated, safe drinking water, causing a spread of diseases. Since most viruses and bacteria thrive in warm places with warm water, it will be even easier for the return of viruses and bacteria along with new ones to occur (WHO, 2003; McMichael et al, 2003). This water is either consumed directly by humans in the form of drinking water or is consumed indirectly through food. According to the Climate Change report by pollution probe, warm waters from the coast combine with fertilizer runoff and produce toxic algae that then affect the commercial fish. In 1987, over 100 people on Prince Edward Island were hospitalized after eating mussels that were contaminated by the toxins released by the algae (McMichael et al, 2003).

The World Health Organization (2003) released a report which linked the number of cases dealing with Salmonella with the rise in temperature in New Zealand from 1965 to 2000. At the conclusion of the experiment, it was discovered that as the average temperature began to rise, so did the number of cases per month; the maximum number of cases per month almost reaching 350. What this could possibly mean is that diseases like Salmonella and E.coli will become more common in numbers due to the rise in temperature (McMichael et al, 2003). Just like Flooding, droughts can cause health problems as well. During the time periods of drought, there is less 'fresh water' present. The roll of this new water is to disperse and dilute the pollutants that are already in the water. Also, lower levels in the lake, stream, or pond means that the water will be at higher temperatures and can allow for algae production, including the dangerous algae and their toxins McMichael et al, 2003).

Climate change is a culmination and a result of all the economically, socially and environmentally unsustainable impacts on the earth's life systems. It is clear that the magnitude and character of the problem of global climate change is such that a community-wide understanding and response is required, albeit guided by policy-makers provided with comprehensive advice from the international scientific community. However, current research gaps need more standardized surveillance of climate-sensitive health states, especially in developing countries (WHO, 2003; McMichael, 2003).

Conclusion

Consideration of the sustainability of human health poses a combination of ethical and technical challenges. These include minimizing environmental damage without compromising the health and well being of today's populations and balancing the health needs of present and future generations (McMichael et al, 1999). A complete health impact assessment goes beyond risk assessment. It also includes an adaptation assessment: an evaluation of society's capacity to adapt to change and of alternative risk management options (McMichael et al, 2003). Challenges are illustrated by the continuing expansion of world food production to provide adequate nutrition for today's 6 billion people. Major stresses are evident in world food-producing systems, particularly land degradation, declining fresh water stores, and fisheries depletion (McMicheal et al, 1999). Unless radial new technologies soon emerge, increase food production will likely promote certain vector borne infectious diseases. However, many developing countries have limited access to these technologies, appropriate information, finance or adequate institutional capacity. The effectiveness of adaptation strategies will depend upon cultural, educational, managerial, institutional, legal and regulatory practices that are both domestic and international in scope.

In order to greatly assist with this global health crisis the United Nations (UN) has a system of organization geared specifically to deal with global issues of this nature and magnitude some of these include: World Health Organization (WHO), Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), International Monetary Fund (IMF), United Nations Children's Fund (UNICEF), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Program (UNEP), United Nations Population Fund (UNFPA), World Food Program (WFP) and the World Meteorological Organization (WMO) (United Nations, 2007).

The pursuit of good population health as a social goal makes little sense unless it can be sustained for future generations (McMichael et al, 1999). There is a debate among economists, some believe that maximizing wealth accrual today, although it may result in short term land degradation, would ensure the ability for future generations to discover, innovate or substitute, thereby restoring the environment. However, others believe that there are great risks to human economies from irreversible changes to nature's infrastructure (McMichael et al, 1999). When the human economic subsystem was small, the regenerative and assimilative capacities of the environment appeared infinite. Humans are now painfully learning that environmental sources and sinks are finite. Originally, these capacities were adequate, but the scale of the human economy has exceeded them (Goodland, 2002).

The link between human health and sustainability reveals that the growing awareness that long term human population health depends on the continued flow of nature's goods and services and the argument for world communities to take concerted action to minimize global environmental change (McMichael et al, 1999). It is quite obvious that acting now to sustain natural capital to reduce future risks to human health would help alleviate many of the existing local and global health problems associated with (McMichael et al, 2003) poverty, inequity, and environmental degradation. According to McMichael et al (1999 and 2003) human health within the sustainability framework enhances the "win win" attractiveness of prompt, prudent and preemptive action on behalf of the global environment.

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