Sustainability Ethics: Zero Net Immigration

by John Cairns, Jr.

> *Noble intentions are a poor excuse for stupid action. Man is the only species that calls some suicidal actions "noble." The rest of creation knows better.*
> – Garrett Hardin

> *The principal selfish interest in unimpeded immigration is easy to identify: it is the interest of the employers of cheap labor, particularly that needed for degrading jobs.* – Garrett Hardin

Large demographic shifts will have many, mostly negative, effects on the quest for sustainable use of the planet. If each nation-state is viewed as a lifeboat, achieving sustainability will require a dispassionate, objective appraisal of the rate at which additional people can be taken aboard without sinking the lifeboat. Each person in the lifeboat will have to relinquish some resources to accommodate each new arrival. In a country, this process means not only ceding one's personal share of resources but also the share of one's descendants in perpetuity. When citizens realize the personal sacrifices necessary for even a modest rate of immigration, attitudes toward immigration should quickly change.

Clearly, any rate of growth that results in an overall population gain is unsustainable. As a consequence, immigration must be viewed in the context of sustainability ethics, which are based on indefinite use of the planet by humankind.

Actually, immigration is only a problem for a few, comparatively large, wealthy countries that attract immigrants like a magnet. Most countries on the planet are already exceeding "lifeboat" capacity, which immigrants recognize even if the leaders and a number of the citizens of the magnet countries do not. The major question of sustainability ethics is how this regrettable situation can be addressed before too many "lifeboats" begin sinking and exacerbate the problem.

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Zero Net Immigration

This article is prompted by an Internet article (Whelan, 2003) and a report (Browne, 2002). The report is a comprehensive evaluation of the economic, social, demographic mass immigration into Britain, which is experiencing the highest levels of net immigration in its history, quadrupling the rate of population growth. The population of Britain increased by 1.02 million between 1992 and 2000 (Browne, 2002). This growth rate is clearly unsustainable. Britain is importing poverty and concomitantly increasing social tensions (race riots have occurred), crime, and public health problems such as TB and HIV. The immigration, at present, is increasing social inequality in Britain because of a massive redistribution of wealth from those who compete with immigrants in the labor market to the wealthy people who employ the immigrants. This type of population flux is well documented in the United States and other countries that have a large number of immigrants (both legal and illegal). Sustainable use of the planet will not be aided by a redistribution of wealth from poor to rich.

The Browne report addresses the way that false accusations of racism have hampered, perhaps even suppressed, legitimate debate about immigration. Lack of discussion has allowed widely believed immigration myths to persist. Examples debunking some of the myths follow.

1. Britain does not have a declining population – more babies are born each year than people die. Even with zero net immigration, the population will grow at a modest but significant rate from 59.8 million in 2000 to 60.3 million in 2020.
2. Britain does not have a declining workforce, but

rather the fastest growing workforce in Europe. The Government Actuary Service estimates that, with zero net immigration, the workforce will grow by 1.2 million in 2020, from 36.89 million in 2000 to 38.127 million in 2020.

3. Britain is not suffering from a demographic time bomb that will place an unsupportable burden of retired people on the working population. The Government Actuary Service predicts that the number of children and pensioners per thousand people of working age will fall from 620 in 2000 to 583 in 2020.

4. Britain is not suffering from generalized labor shortages. According to the Labour Force Survey, there are 1.55 million unemployed people in the United Kingdom. Another 2.3 million are out of work but want to work – they do not look for work largely because they do not believe they will be able to secure jobs that pay well enough (Browne, 2002).

5. Immigration is no "fix" for an aging population, because immigrants grow old, too.

6. Immigration does boost gross domestic product (GDP); evidence does not indicate that immigration raises the level of the one measure that matters, GDP per capita.

7. Immigrants from developing countries, who make up the entire net immigration to the United Kingdom, are on average less well educated, suffer higher unemployment, claim more of most forms of benefits, make more demands on public services such as schools and hospitals, and almost certainly do not have funds to pay for these services. The Browne report calls attention to official studies in the United States showing that average Mexican immigrants will consume, throughout their lifetime, $55,200 more in services each than they contribute in taxes. (As an aside, the state of California, with a large number of legal and illegal Mexican immigrants, is now in deep financial trouble due, in part, to this imbalance between what an immigrant contributes and what he or she uses.)

8. Immigration is culturally enriching, but there are decreasing economies of scale. Doubling the immigration rate does not double the amount of cultural enrichment.

9. The poor are often the losers.

10. Those who benefit from immigration are those who employ immigrants (e.g., companies that exist on cheap labor).

11. The immigration-led rapid growth in population sharply increases the demand for new houses, which increases the pressure to build on greenbelt land.

12. Large-scale immigration without integration causes social fragmentation.

13. Immigration deprives most poor countries of their most educated and entrepreneurial individuals, often devastating health, educational, and other important systems. Immigration deprives developing countries of tax-paying and politically stabilizing middle classes.

This "must read" report concludes that a balanced, sustainable immigration policy for Britain is essential (and one might add, for the rest of the world). Since Britain is one of the world's most crowded countries, with a naturally growing population, the optimal level of net migration is zero or mildly negative.

This information-packed, well-reasoned report is essential reading for anyone interested in sustainable use of the planet. The issues and conclusions fit the United States quite well and doubtless most, arguably all, developed countries. As the report notes, immigration (by allowing people to move where they can maximize their welfare and get maximum return on their skills) is a definite force for good in the world as long as it does not result in unbalanced, unsustainable, and destabilizing population flows. The contrast with Japan, where migration flows are likely to be limited, balanced, and beneficial, deserves much more attention.

The Lifeboat Metaphor

Nearly three decades ago, Hardin (1974) conceived the lifeboat metaphor, in which each wealthy nation is comparable to a lifeboat occupied by comparatively wealthy people. The world's poor (at least two-thirds of the global population) are in other, much more crowded lifeboats. The poor hope to be admitted to a rich lifeboat or in some way to benefit from the resources it has. However, as Hardin (1974) notes: *each lifeboat is effectively limited in capacity.*

What makes the zero net immigration report (Browne, 2003) so important is that it provides compelling evidence that one of the "wealthy lifeboats" is full and cannot accept any more occupants without endangering the lifeboat (i.e., Britain) itself. No new, rich lifeboats are forthcoming, so exceeding the capacity of one lifeboat will mean that the world has one less! With no new, wealthy lifeboats forthcoming and the remaining wealthy

lifeboats full, what will happen then? First, humankind will be forced to instigate many measures that are now repugnant to society. Second, sustainable use of the planet will be even more difficult to achieve. Third, individual "rights" will diminish because society will realize that rights are all dependent upon the health of the planet's ecological life support system, consisting of natural capital and the ecosystem services it provides.

Population and Demographic Issues

Humankind lives in an era of unprecedented demographic change (Global Science Panel on Population and Environment, 2001). Global population increased by 2 billion during the last quarter of the 20th century, reaching 6 billion in 2000.The Global Science Panel (2001) notes the need to heed the first principle of the 1992 Rio Declaration: "human beings are at the center of concern for sustainable development – *by taking full account of how population and society interact with the natural environment* (italics mine)." Sustainable development is clearly homocentric, but concern for the integrity of the natural environment is ecocentric. Therefore, sustainability ethics (Cairns, 2003) must be both homocentric and ecocentric.

This era is also a time of unprecedented demographic diversity. Traditional demographic groupings of countries are breaking down. Rapid population growth has exacerbated climate change and led to the depletion of groundwater aquifers, old growth forests, oceanic fisheries, and agricultural lands, to mention just a few of the many problems. Furthermore, changes in population size, age distribution, and demographic distribution complicate developing a harmonious relationship with the planet's ecological life support system. In a time of rapid technological and population growth, the rate of social change is inadequate.

The Ethical Problems

Hardin (1968) defined the commons as "a resource to which a population has free and unmanaged access." He also coined the term "commonism" to replace "one-worldism," which was then, arguably, more popular than it is today. Hardin also noted: "Charity begins at home." Why the restriction? He felt that the greater the distance between the donor and the recipient, the more likely that well intended charity would cause more harm than good. In short, ethical positions must be compatible with managing the global commons that permit modification to meet specific, unique, local ecological and social conditions without endangering the larger system. Since some of the social changes necessary to achieve sustainable use of the planet will be regarded by many as bad news, the bearers are labeled "prophets of doom"; "good news," however implausible (e.g., continued exponential growth on a finite planet), is hailed as exuberant optimism by some of the world's leading news organizations. A considerable increase in both environmental literacy and ethical responsibility is essential to combat these views.

Immigrant Sponsors

On March 11, 2003, U.S. Congressman Tom Tancredo (R-CO) called on all the governors of the states to consider utilizing section 213A of the Illegal Immigration Reform and Immigrant Responsibility Act of 1966, which ensures that reimbursements are sought from sponsors who have filed affidavits of support on behalf of aliens receiving public benefits. Tancredo notes that state budgets are already strained to an incredible degree, which has, in most states, required reducing money for education, closing some regional state offices, reducing aid to needy and elderly citizens, and the like. This provision allows states and/or countries to recoup some of the cost for providing social services, including Medicaid, to legal immigrants.

In the United States, the requirement of sponsorship of aliens entering the country is a century old provision of law, which was designed to prevent welfare from becoming the promise of the good life in America. Even when the law was adopted, evidence was available that immigration was a strain on the integrity of the country. Now, a century later, these concerns are still valid. Added to them is a new concern – the United States is at the limit of its carrying capacity if the present quality of life is to remain high for current citizens and for posterity. Zero net immigration may yet be an issue for the powerful, wealthy United States.

Temporary Compassion

Hardin (2001) described the flaw in preventing immigration as unconditional provision of help to the "needy."

> *Those (1,000,000) who are hungry are reproducing. We send food to them (1,010,000). Their lives (1,020,000) are saved.*

> *But since the environment is still essentially the same, the next year they (1,030,000) ask for more food. We send it to them (1,045,000); and the next year they (1,068,000) ask for still more. Since the need has not gone away, it is a mistake to speak of a passing crisis.*

In this way, perceived kindness, altruism, or compassion can exacerbate the problem. Still, the solution of just supplying food is more "comfortable" and is short-term, even though the cure (population control), including immigration, is repugnant but more likely to be successful long term. Posterity-blind ethics is a major threat to achieving sustainable use of the planet!

Whose Life is Sacred?

Among the definitions of sacred in the *Random House Dictionary* is "…secured against violation, infringement…" If zero net immigration were the policy of each nation-state, the chance would at least be possible of not violating lives of future generations. Of course, a nation-state could still permit the population within its borders to grow beyond its carrying capacity. However, if excess population had no place to go, either the nation-state or nature would reduce the population numbers to the carrying capacity level. The marked tendency is to forget that humankind lives on a finite planet, so population stabilization, even reduction, must eventually occur.

The *sine qua non* of both eco-ethics and sustainability ethics is maintaining the integrity of the planet's ecological life support system. Sustainability ethics also emphasizes leaving a habitable planet for future generations. As conditions continue to worsen due to the continuation of unsustainable practices (e.g., exceeding carrying capacity), decisions will become more emotionally difficult. Making no decisions will ensure that population size will be determined by harsh, natural processes (e.g., disease, famine). By contrast to this scenario, zero net immigration seems compassionate.

Each nation-state has the responsibility to ensure that its citizens are not compelled to leave it to become a burden on another nation-state. Each nation-state has the additional responsibility to ensure that the strikingly evident misery of some of those now alive is not reduced at the expense of a much larger posterity. By accepting high unsustainable rates of immigration, nation-states, such as the United States, are enabling the exporting nation-states to continue their unsustainable practices while endangering the future of the descendants of its present inhabitants.

Trying to Reduce Emigration

India uses the energy equivalent of one barrel of oil per year per capita. The United States uses 60, and the world average is 10. If India began to use just the world average, the equivalent of approximately 5 billion barrels of oil or its equivalent in energy would be required. Clearly, humankind cannot bring per capita consumption of oil in India even to the world average, and the probability of increasing per capita consumption in India to the US average is zero, for all practical purposes. The environmental effects of such levels of usage would be disastrous. Still, the United States is an immigration "magnet" for all people aspiring to a high per capita energy use. Sending more oil to other countries might reduce emigration but would not eliminate it. The only way to reduce massive immigration into the United States and other magnet countries is zero net immigration laws.

The situation with regard to food is less daunting but still formidable. Wealthy countries use approximately three times as much grain and the like per capita than poor countries. Even so, with billions of malnourished people on the planet, sending food without requiring population stabilization will almost certainly cause more harm than good, as some classic case histories demonstrate. Zero net immigration laws in the "magnet" countries are a logical but painful first step toward sustainability.

Conscience: The Lowest Possible Denominator

Any system in which compliance to any need is ruled by conscience alone will abundantly reward those with a lack of conscience. In my town of Blacksburg, Virginia, USA, most sizable establishments (e.g., shopping malls, nursing homes, etc.) have special parking spaces for the handicapped, usually with good access to the entrance. Since I acquired a temporary tag for handicapped five months ago, I have had daily opportunities to observe compliance. Even though the state fine for unauthorized use of these spaces is hefty, I have observed numerous violations. These observations have been to satisfy my curiosity, so they merely illustrate that conscience alone would probably result in even more prized parking spaces being used by

individuals with a lack of conscience.

Environmental Surprises

Unaddressed, long-range problems will soon reach severe crisis stage and will be labeled emergencies. However, they should be viewed for exactly what they are—failure to replace unsustainable practices with sustainable practices. These crises and emergencies will almost certainly occur during the first half of the 21st century when the global population is expected to grow by more than 70 million per year.

A superb and frightening illustration is the interlocking food, water, and energy situation. World water demand has tripled over the last half century and has exceeded the sustainable yield of aquifers in scores of countries, which has led to falling water tables (Brown, 2003). The unsustainable solution to this problem has been to over-pump the groundwater; however, this action only ensures a more rapid depletion of the remaining aquifers when wells go dry. As a consequence, the probability of nearly simultaneous exhaustion of fossil water supplies is greatly increased. The lack of water, in turn, will result in major reductions in grain harvests in many countries at approximately the same time.

The problem of falling water tables exists in three major exporters of grain – the United States, Canada, and Australia. These countries have highly mechanized agricultural systems that would be further disrupted by any reduction in fossil fuel availability. Global warming resulting in sea level rise could impair coastal agricultural systems. Climate change will almost certainly further disrupt the agricultural systems worldwide.

All the above factors, together with many others, will increase the number of environmental refugees (Cairns, 2002). Arguably, no country is capable of absorbing immigrants in the long term, even the United States, Canada, and Australia. Nor do these three countries have such a large surplus of grain that they are likely to be able to absorb immigrants in the long term because they, too, are having water problems. For example, Postel (1999) uses data for India, China, the United States, North Africa, and Saudi Arabia to estimate the annual water deficit, in terms of aquifer overuse, at over 160 billion tons per year. The Food and Agricultural Organization (1979) uses the rule of thumb that 1,000 tons of water is needed to produce 1 ton of grain; 160 billion tons of water would produce 160 million tons of grain. The U.S. Department of Agriculture (2002) estimates that, with present world grain consumption of 300 kilograms per person, this would feed 533 humans.

Clearly, drastic measures are needed to address this problem before it worsens. Since grain-exporting countries are really "exporting" water, any reduction in supply for agriculture (e.g., higher water use by industry or municipalities) could swiftly cause a major crisis. Zero net immigration is not a "cure all" for this situation, but it would bring the issue into sharper focus. As the situation worsens, the numbers will be so large that compassion for individuals, especially aliens, will be increasingly difficult, especially if the citizens of potential host states are suffering new hardships. Furthermore, the conditions in the nation-states exporting people will become proportionately worse.

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For example, World Bank data indicate that the water table in most of Yemen (population approximately 17 million) is falling by approximately 2 m per year as use far exceeds the sustainable yield of aquifers. At the capital of Sana, the water table is reported to be falling at a rate of 6 m per year. The World Bank estimates that the aquifer will be depleted by the end of this decade.

To maintain the water supply, the Yemeni government has drilled test wells in the basin as deep as 2 km without finding water. The inhabitants will soon be forced to relocate within the country or migrate abroad (Ward, 1998). Accepting immigrants from Yemen will not alleviate the water problems in Yemen and will worsen the situation in the host country. When one considers the issue at a systems level, zero net

immigration seems to be a rational, but still unpalatable, option.

Ethics for Zero Net Immigration

Formulating ethics that apply to zero net immigration requires considering (1) whether attempts should be made to succor people who have in some way caused the local, regional, or global population to exceed the carrying capacity of the ecosystem upon which posterity will depend or (2) whether increasing risk to the ecological life support system is justified. The decision is multiplied in difficulty since exceeding the carrying capacity is affected by cumulative, unsustainable decisions of a large number of humans. Although the decisions may be viewed as individually insignificant (as they are), in the aggregate they exert a terrible tyranny upon humankind.

Lurking not far in the background is the certainty that nature's laws will become effective, as they do when any other species on the planet exceeds the carrying capacity of its habitat. When nature becomes the equalizer, huge numbers of individuals die or suffer greatly, but the species is usually preserved. In short, a terrible price is paid for exceeding carrying capacity limits. Motives, compassion, altruism, guilt, remorse, and other human attributes not purportedly characteristic of other species simply do not matter when nature's laws are violated. Neither will these characteristics have significant impact on natural law.

Human nature usually exhibits compassion for a woman (or couple) who has 11 children when the ecoregion cannot tolerate exponential growth. However, in order to survive, nation-states or other political entities cannot tolerate any action that further increases its human population if the action leads to exceeding carrying capacity. Countries or political entities that permit their population to exceed carrying capacity face problems that affect their ultimate survival.

Much evidence indicates that global carrying capacity either has already been exceeded or that capacity will be reached in the first half of the 21st century when the human population may reach 10 billion. What then? The global population will have increased from slightly over 6 billion in 2000 to 10 billion in just 50 years. To be optimistic about the outcome is stupid, but adopting an optimistic attitude enables people to avoid or postpone difficult ethical decisions. The time to make these unpalatable decisions is now. No miracle of technology can replace an ethical decision. Some preliminary ethical positions follow.

1. I pledge to maintain the planet's ecological life support system and that of my area for posterity even if it requires hard decisions on immigration.

2. I affirm that individual freedom must be accompanied by individual responsibility if humankind intends to achieve sustainable use of the planet. I pledge to do whatever I can to help unfortunate humans in other countries, but not at the expense of my own country's future, even if this refusal requires zero net immigration.

3. I affirm that freedoms diminish as the world becomes increasingly crowded and natural capital diminishes. If individuals, even a significant minority, fail to act responsibly, then coercive measures, such as zero net immigration, are the inevitable result.

4. I affirm that, in the absence of a strong, world political system, nation-states must control human migration with zero net immigration if regional carrying capacities are not to be exceeded.

5. I affirm that the costs of immigration, such as health care, welfare, education, etc. must be met entirely by the sponsors of the immigrant. To avoid default, sponsors must be bonded to insure that financial responsibilities will be met.

Arguments to Continue Immigration

People who favor immigration tend to resist imposition of limits to immigration by citing countries that have both high population densities and a concomitant high standard of living or by employing character assassination of those who oppose immigration (e.g., calling them racists). Zero net immigration is too new a concept to make a final judgment about the tactics of those who oppose it, but, presumably, they will merely mimic the tactics used against those who wish to restrict immigration. Some illustrative examples follow.

1. THE NETHERLANDS FALLACY

This argument is used often, especially in Australia, Canada, and the United States – these countries are less densely populated than many areas of the world (i.e., lots of "unused" space) and have a comparatively high standard of living. The rebuttal to this argument is the recent literature on ecological footprint size (e.g.

Wackernagel and Rees, 1996), which beautifully illustrates that the space one inhabits physically is often far less than the space required to furnish food, energy, and other resources essential for an individual's survival (small ecological footprint) or to use material resources in a profligate way (large ecological footprint). Examples based on islands usually aid in visualizing footprint size. Both Bermuda (small) and Japan (large) are island nation-states with fairly dense populations and a comparatively high standard of living. Both import resources, including petroleum, food, and wood products, from areas well beyond their political boundaries.

2. ACCUSATIONS OF BEING SELFISH

Wealthy countries are inevitably "magnets" for poor people from impoverished countries. Inhabitants of wealthy countries feel guilty when they oppose mass immigration (e.g., in the United States, legal immigration now exceeds 1 million per year and net illegal immigration is estimated at 0.5 million or more per year). Ironically, prospective employers that merely want cheap labor are seldom accused of being selfish.

3. THE FALLACY OF NATIONS WITHOUT BORDERS

One prevalent myth is that the world's population problem can be solved by mass inter-nation migration. In fact, the assertion taken to its extreme would mean no borders and people moving where and when they wish. However, the numbers do not support this assertion—if developed nations accepted just the annual population increase of less developed nations, developed countries would have to accommodate 53 million immigrants annually. This increase is an annual population growth rate of 6.3% and a doubling time of 11 years (Population Reference Bureau, 1975).

4. DEVELOPED COUNTRIES MUST COMMIT TO THE FATE OF DEVELOPING NATIONS

Most studies of international migration have focused intently on the effects of immigration on the recipient country and the plight of individual immigrants. However, some very skilled, highly educated people are immigrants. The term "brain drain" was originally applied to the loss of "highly-skilled-with-great-potential" persons from Europe, which had been war torn during World War II. Some American universities greatly improved their stature by recruiting large numbers of these "brains," such as Albert Einstein. Even developed countries would suffer significantly if they lost a sizable portion of their best educated, most skilled, and most creative people.

5. DEVELOPED COUNTRIES IMPROVE LOW ECONOMIC STATUS OF IMMIGRANTS

Developed countries use unskilled immigrants as unskilled labor and perpetuate a low economic status for them by not emphasizing and funding birth control methods so that family size is much reduced. Large numbers of children mean that the family, the parents, and society cannot afford to increase educational levels, thus keeping these children in the unskilled labor pool. For example, Mexico is a major source of both legal and illegal immigrants to the United States. This situation is due to the simple fact that Mexico's resource growth does not keep pace with its rate of population growth.

What Does the Present Generation Owe to Posterity?

How can a finite planet be kept habitable for an infinite period of time? Obviously, the finite planet must not be damaged. Clearly, the human population of the planet must stabilize at some point in the near future. As a result of immigration, reduced birth rates in the citizenry do not necessarily lead to population stability. Leaders are badly needed to address this issue and to persuade followers to implement change. Rulers tell subjects what to do—some individuals start as leaders and then become rulers, a dangerous situation at best. In general, humankind's bequest to posterity has not been thoroughly discussed and reasoned. The most charitable view of this failing is that humankind did not grasp what an impact it had on natural systems. Of course, the economic component (e.g., property) of an inheritance that is left to one's immediate descendants (i.e., family) has always been of major importance. A few wealthy individuals (e.g., Andrew Carnegie) have left libraries and foundations to present and future generations. Some effort has even been made to protect endangered species. However, in-depth discussions have been lacking on the effects of population growth; migration, including immigration; economic development; ever-increasing human artifacts (e.g., cities, highways); technological change upon other life forms; and the quality of life future generations might experience.

Economist Solow (1993) believes that, since present generations have no idea of the choices future generations will make, present generations cannot plan for future generations. Further, Solow believes that humankind is not required by the concept of sustainability to leave any object or goal or obligation for posterity. In short, Solow believes the economic bequest, rather than the environmental one, is most important. Basically, the economic bequest views the primary obligation as each generation either adding to or protecting the economic capital base it inherited. The environmentalist's view is that natural capital is the basis of all other capital, and all aspects of nature must be given at least as much protection as it enjoyed in the present generation (at a minimum) and should be increased at best.

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The primary obstacle to a rapprochement between economists and environmentalists is the viewpoint of some economists of substitutability between natural and human-produced resources. The situation is exacerbated because the descriptors *sustainability*, *sustainable development*, and *sustainable use of the planet* contain, at present, a number of conceptual ambiguities that need to be resolved. Another major obstacle is the tendency of environmentalists to use empirical observations of an array of somewhat unique ecosystems that are often site specific (e.g., Ehrenfeld, 1993). Economists frequently use highly aggregated data to develop mathematical models (e.g., Waldrop, 1992). The resemblance of these models to the "real world" may be problematic.

Daly (2003) has superbly analyzed the vision of steady-state economics. He contrasts the "open" system as one with a "digestive tract" – matter and energy are taken from the environment in low-entropy form (raw materials) and returned to the environment in high-entropy form (waste). A "closed" system is one in which only energy flows through, while matter circulates within the system. On a global scale, human society is a long way from reaching this desirable, sustainable "closed" system goal. Either exponential population growth or an increase in the size of the ecological footprint places a strain on the entire system, which threatens the steady-state condition. Until sustainable use of the planet becomes a reality, zero net immigration will stabilize a critical variable. It makes no sense to seek a steady-state condition (i.e., sustainable goal) if the most important variable can change rapidly.

Major Variables

World population growth, arguably the most important variable in achieving sustainability goals, has been slowing from 87 million per year in 1987 to 74 million per year in 2001 (US Bureau of the Census, 2002). However, the global total of living persons is now over 6.2 billion. Most growth is in developing countries, with the 49 poorest countries in the world having an annual increase of 2.4% per year (United Nations, 2002). This seemingly low rate still produces a doubling time of 30 years (70 divided by 2.4). This calculation means providing twice as much food, housing, medical care, education, etc. every 30 years. Doubling time is a much more effective way of viewing the population growth because, to most people, a 2.4% increase seems modest. This population increase in the poorest countries will inevitably lower the quality of life and result in increased migration, which makes maintaining a stable population more difficult even in wealthy countries. A dynamic "steady-state" is also difficult to achieve under these conditions. Emigration has slowed population growth in developing countries, but has not led to staying within the regional carrying capacity.

Although 3.1 million people died of AIDS-related causes in 2002 and 5 million became HIV positive (Joint United Nations Programme on HIV/AIDS, 2002), this horrific problem has only minimally reduced population growth. Disease is not a desirable means of stabilizing population size.

Indicators other than population size and growth indicate that the planet's carrying capacity has been

reached or exceeded. The world's cereal grain stocks have declined precipitously to approximately 466 million tons at the end of 2002, the lowest level in 40 years of record keeping (Halweil, 2003). The world's consumption of meat continues to grow (Nierenberg, 2003). A meat eater's diet requires two to four times as much land as a vegetarian's diet (Nierenberg, 2003). The International Energy Agency projects that global primary energy demand will increase 1.7% annually between 2000 and 2030 (Sawin, 2003), a doubling time of 42.35 years. Persuasive evidence shows that the global warming trend, which accelerated in the 20th century, is linked with the buildup of carbon dioxide and other heat-trapping gases (Sheehan, 2003). Arguably, the worst effect of global warming may be on the millions of species that collectively constitute the planet's ecological life support system. Peters and Lovejoy (1992) have provided information on the numerous ways that global warming could affect biological diversity. Changes in biological diversity, in turn, will inevitably affect humankind in a variety of ways, from the loss of pollinators of agricultural crops to changes in the growing season of cereal grains and the rainfall patterns they require.

Economic Growth

Although economic growth has increased (2.5% in 2002; Assadourian, 2003), the change was by no means uniform globally. In Africa, per capita growth was only 0.3% because the population increased by 18 million (US Bureau of the Census, 2002). Globally, the per capita gross world product (GWP) only increased 1.3% because governments had to expand infrastructure for population growth (US Bureau of the Census, 2002). Since economic indicators play such an important role in all decisions at present, the challenge to GWP as an accurate measure of economic growth and progress is a key issue (Organization for Economic Cooperation and Development [OECD], 2001). The GWP uses all expenditures as positive contributions regardless of their worth to society and omits key economic sectors, such as subsistence farming and household maintenance (OECD, 2001).

Redefining Progress, a US nongovernmental research group, has developed the genuine progress indicator (GPI), which subtracts costs to the economy, such as traffic congestion, pollution, and crime, but adds elements not included in the GWP, such as unpaid childcare and volunteer work. This method of calculation makes a substantial difference—in the United States, per capita GDP grew 77% from 1975-2000; in contrast, the GPI growth was only 2% (Cobb et al., 2001; Assadourian, 2003). Neither calculation includes ecosystem services, which Costanza et al. (1997) estimate are worth from $18 to $62 trillion. Daily and Ellison (2002) also provide information on estimating costs of ecosystem services. Low GPI growth should cause concern about all kinds of human migration, including immigration. From an ecocentric viewpoint, a zero net immigration rate makes sense. The average land available to each human on the planet is 1.9 hectares (Wackernagel et al., 2002); consequently, as the global population grows, the hectares available per person on the planet shrink. Migration of all sorts, especially immigration, becomes increasingly less attractive.

A primary cause of migration is the striking difference between per capita GDP in the poorest and richest nations (which was 37 times in 1995; World Bank, 2002). As long as the hope exists that migration is the solution to a quality life, the incentive to live sustainably where a person resides is lessened. Reallocation of resources will almost certainly occur in the 21st century; the unanswered question is whether the change will be by revolution or by political and humanitarian means.

Adjusting to Uncertainty

One great global uncertainty is how much deviation from the nominative ecological state will trigger a disequilibrium or instability. Thresholds for instability exist but are unknown (e.g., Mastrandrea and Schneider, 2001). This uncertainty often results in environmental surprises. One strategy for coping with surprises is avoidance; another is to do whatever is possible to minimize the occurrence of a surprise (Kinzig et al., 2003). However, even if an avoidance strategy could be made operational, it would not be desirable (Kinzig et al., 2003). For example, Kinzig et al. speculate: if some small probability exists that a fishery would collapse in any given year and, moreover, that this likelihood was an increasing function of the level of fishing, then the avoidance strategy would demand that people never fish. This strategy would violate the principle of tradeoff that underlies all good decision making. The likelihood of a collapse must be traded off against the lost benefits, both economic and social, from fishing. Examples of alternative strategies to use in managing surprise, including anticipation of surprise and coping with

inevitable surprises, are useful (e.g., Berkes et al., 2002).

Mastrandrea and Schneider (2001) note that the amount of disturbance needed to trigger an instability is uncertain. However, the results from ecological restoration (e.g., National Research Council, 1992) suggest that partial restoration of ecosystem integrity is possible. This possibility diminishes the instability problem by reducing or eliminating some of the variables that push a system toward a threshold. If ecosystem integrity and resilience are partially or nearly completely restored, then at least the risk of irreversibility is reduced, but not eliminated.

Similarly, the assertion that an avoidance strategy cannot be made operational and, if it were, it would not be desirable (Kinzig et al., 2003) may be valid if ecological restoration is not implemented at the first observation of deleterious effects. Ecosystems, like individuals, are more likely to resist stress if they are healthy and robust. Gunderson and Holling (2002) note that the resilience of most all environmental systems is characterized by linked spatial and temporal scales. Carpenter et al. (1991) have provided persuasive evidence that excessive phosphorus loading of a lake can cause damage that cannot be reversed by simply eliminating the loading. Unquestionably, irreversible effects occur. Maintaining ecosystem health and integrity may reduce the probability of irreversibility, but, until there are more robust assessments of these attributes, the dangers of irreversibility are substantial.

As Kinzig et al. (2003) note, a certain world begets certain "best strategies" for survival; on the other hand, an uncertain world necessitates a larger portfolio of options and approaches and the means for choosing among them. Kinzig et al. (2003) also believe that the cost of "incorrect knowledge" is quite high, affecting not only that building block in the foundation but those that follow. Arguably, the largest factor of uncertainty regarding sustainable use of the planet is lack of knowledge of critical ecological thresholds (e.g., Cairns, 1992). Systems with greater temporal and/or spatial scales are less likely to have thresholds that have been investigated or even recognized. Developing laboratory tests for thresholds at the global level is impossible, and even difficult at the landscape level.

The societal experiment with global warming is an illustration of this issue. Persuasive evidence indicates that the planet is warming, but no precise determination has been made of the level or rate of temperature rise that will cause severe ecological disequilibrium. Humankind is walking blindfolded toward a precipice of unknown depth or distance. The edge may be a kilometer or a meter away, but humankind does not know how far the edge is or how serious the fall will be after encountering the edge. Major ecological thresholds may be as abrupt, but it is also possible to cross thresholds without immediately being aware of having done so. The knowledge of complex, multivariate ecosystems is not robust, so the nature of early warning criteria is necessarily inadequate. Under these conditions, prudence demands precautionary steps to avoid crossing the threshold. Limiting the production of greenhouse gases and stabilizing population are two such steps.

"Reallocation of resources will almost certainly occur in the 21st century; the unanswered question is whether the change will be by revolution or by political and humanitarian means."

If the global ecological life support system is placed in disequilibrium, it will eventually establish a new, different, dynamic equilibrium that may or may not be favorable to humans. Even if favorable, the conditions may be less favorable to humans than the present ones. Humans are a critical variable, so stabilizing the population in every country is essential for reducing the dangers of crossing a major climatic threshold.

One of the most important thresholds is the number of humans the planet can support. This estimate is exceedingly difficult to calculate because of the many variables involved (Cohen, 1995). Despite recognition of the basic problem by the Reverend Thomas Robert Malthus (Malthus, 1798), humankind has mostly ignored his basic thoughts. Although the controversy has persisted for over 200 years, it was intensified by

Ehrlich's (1968) book *The Population Bomb*. The Union of Concerned Scientists (1992) issued a warning that then current unsustainable practices could not continue. Abernethy (1994) attributed optimism about population growth as the cause of lack of attention. Orr and Ehrenfeld (1995) believe humankind is in denial about ecological problems. Ehrlich and Ehrlich (1996) believe rejection of environmental evidence, including population problems, is a betrayal of science and reason. The lack of attention to the problems of population is probably a combination of all these factors.

Some scientists, possibly attracted by large consulting fees, make statements that could not survive peer review. Humans have betrayed reason because common sense tells them that exponential growth on a finite planet is unsustainable. As is the case for alcoholism and other unhealthy addictions, denial is the recourse chosen by those who prefer not to contemplate the consequences of their practices. Zero net immigration is just the latest concept to encounter these obstacles. No amount of scientific evidence will persuade most of the people who dodge reality; however, for some, overwhelming evidence may cause a paradigm shift (e.g., Kuhn, 1970). If reason and evidence do not prevail, the consequences of assuming humankind is exempt from nature's laws are likely to be severe, even appalling. As the stock market has demonstrated in recent years, no curve continues upward forever. Humans must level the curve voluntarily or nature will do so; nature may even impose a declining curve.

Estimating the Potential for Immigration

EXPECTATIONS: THE IMMIGRATION DRIVE

Most immigration is almost certainly the quest for a better life, which is generally evidenced by material possessions. Nowhere is the difference in material possessions more evident than in Menzel's (1994) graphic pictures and text. Just the two pictures on the cover of his volume illustrate the enormous range of material possessions on the planet. Regardless of the current amount of material possessions, the general vision of the future is for even more. The affluent countries draw immigrants (both legal and illegal) as iron filings to a magnet. Earth simply cannot stand the drain on resources that would be needed to raise all of Earth's 6.3 billion people to the level of material affluence of the United States, Canada, and other wealthy nations. In addition, immigration is not a satisfactory way to achieve equity and fairness in resource use.

ECOLOGICAL FOOTPRINT SIZE: METRICS FOR NOT EXCEEDING CARRYING CAPACITY

Carrying capacity is a function of resource availability per capita. Resources needed per capita is a function of whether one contemplates living at an optimal or a subsistence level. This complex issue is explored in detail by Cohen (1995). Wackernagel and Rees (1996) have produced a superb system of depicting resource use – the ecological footprint size. An Internet display of the details of the concept of ecological footprint size can be found at http://teacherbridge.cs.vt.edu/public/users/cjervis/apbiology/Home under "sustainability" then "additional resources." The ecological footprint of nations can also be calculated (http://www.ecouncil.ac/rio/focus/report/english/footprint/ranking.htm). This calculation is important because immigrants are attracted to countries appearing to have high resource consumption per capita. The Internet site gives these footprints sizes: United States, 10.0; Australia, 9.0; Canada 7.7 (as of December 1997; in hectares per capita). The world average is 1.7 hectares per capita. Individuals in impoverished countries will take considerable risks in attempts to immigrate to those countries with a large ecological footprint.

Nations experience an ecological deficit when their ecological footprint exceeds the biologically productive area of the country (e.g., Singapore, -7.1; United States, -3.6; Netherlands, -3.6; Germany, -3.4; Japan, -3.4). These and other countries with ecological deficits are living beyond their carrying capacity by importing resources. Clearly, no nation with an ecological deficit should be accepting immigrants unless citizens are willing to reduce their individual ecological footprint to accommodate immigrants.

Sharing Resources with Nonhuman Species

The United Nations World Commission on Environment and Development (1987) suggests that 12% of the planet's ecological capacity, representing all ecosystem types, should be preserved for the protection of biodiversity. The report recognizes that 12% may not be enough for securing biodiversity, but that conserving more may not be politically feasible. In short, 12% of the

planet is allocated for 30+ million species – 88% for one species, *Homo sapiens*. This allocation is not a prudent way to treat the planet's ecological life support system. Added to this imbalance is the exponential growth of humankind, which will surely produce large numbers of environmental refugees as natural capital is depleted and ecosystem services diminished. Even without further ecological degradation, the amount of available, biologically productive space will drop from 1.7 hectares per capita to 1.0 hectare per capita if global human population reaches the estimated number of 10 billion in the 21st century. Mass human migration is not a viable solution to this problem.

Equitable Distribution of Resources

Evidence is not robust on how much of the planet's resources are necessary to preserve the integrity of Earth's ecological life support system. Present trends in biotic impoverishment, including habitat loss, indicate that 12% is well below a sustainable level. The percentage allocated should be based on ecological reality rather than political feasibility.

Conclusions

Zero net immigration is a first step in the determination of the carrying capacity of each country. For developing countries, zero net immigration would mean an end to emigration as a temporary means of exceeding carrying capacity limits. If a finite planet must not exceed global carrying capacity, then the unavoidable conclusion is that each country must not exceed its carrying capacity. If too many countries exceed their carrying capacity simultaneously, the opportunity for a compassionate solution to overpopulation is markedly diminished. A major first step would be for nations with very large ecological footprints and a substantial ecological deficit (e.g., the United States) to implement zero net immigration.

Of course, zero net immigration is only one of the many requirements of sustainable use of the planet. Population stabilization is essential to zero net immigration. The vast difference in the size of the ecological footprint must be reduced both at the country and individual level. The actual size of the ecological footprint that will be compatible with sustainable use of the planet will be determined, in large part, by the need to protect the health and integrity of the ecological life support system. In short, a fair and equitable allocation of resources is essential, including space, between humans and the 30+ million fellow species with which *Homo sapiens* shares the planet.

Metrics for determining the health and integrity of the ecological life support system are in the early developmental stages, so the determination of thresholds that must not be crossed is not precise. High uncertainty requires using every precaution to remain well below critical thresholds for optimal results since crossing these thresholds will result in harsh penalties. The best way to succeed in protecting the health and integrity of the ecological life support system, consisting of natural capital and ecosystem services, is to make this aspiration a primary goal. This undertaking will require that humans not exceed carrying capacity anywhere on the planet and that the human economic system (now a throughput system) be regarded as a component of the ecological economic system (a recycling system).

Furthermore, the human economic system must be restructured to a recycling system in which wastes of all sorts can be reincorporated beneficially into the planet's ecological life support system. Consequently, human population cannot grow exponentially and then respond to ecological problems by migrating to another country. One important component of this transition should be zero net immigration, coupled with internal population stabilization.

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