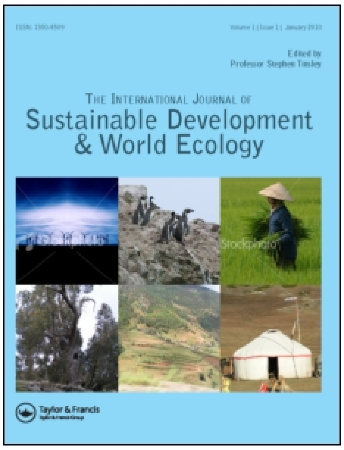

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Disarming the population bomb

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This paper argues for a renewed international focus on managed population reduction as a key enabler of sustainable development. The paper presents development data that demonstrate why population reduction should be elevated to share top priority with poverty alleviation, as the two over-arching goals of international development strategy. The critical analysis put forth in this paper argues that the current 'unsustainable' approach to sustainable development stems from (1) 'empty world' economic growth theory applied to a 'full world', which is (2) supported and driven by socioeconomic incentives to expand population, (3) justified through flawed interpretation of demographic transition theory, (4) bolstered by the exaggerated efficacy of environmental economic theory applied in a resource-constrained world, (5) insulated from challenge by limitations of scientific knowledge and (6) perpetuated by herd behavior. This paper concludes that failure to reduce global population will inhibit attainment of poverty alleviation and worsen environmental degradation.

Keywords: sustainable development; overpopulation; poverty alleviation; economic policy

Introduction

The mysterious stone Moai statues of Easter Island have been attributed to a technologically savvy civilization which depended on forests for sustenance. Trees prevented soil erosion and provided wood for heating, building habitats and creating ocean-going canoes that permitted fishing. As the forests on Easter Island diminished, so too did the capacity of the islanders to sustain themselves. With resources in short supply, tribal conflicts ensued and exacerbated societal decline. In short, the downfall of this civilization, much like the downfall of the technologically advanced Norse and Mayan civilizations, evolved out of avaricious consumption practices which overwhelmed the ecosystems upon which the society depended for subsistence (Diamond 2005). Today, there are indications that the unsustainable consumption practices in evidence on Easter Island are now manifest on a global scale. The question is, will history repeat itself or is humanity capable of breaking free from unsustainable development ideologies?

This paper presents a critical analysis that concludes that failure to address global overpopulation will catalyze amplified depletion of natural resources, enhance levels of global poverty and impair humanity's capacity to rectify these problems in the future. This analysis makes four primary contributions to the field of development policy. First, it quantitatively demonstrates why population reduction policies should share top priority with poverty alleviation policies as the two over-arching directives of international development strategy. Second, it introduces a quantitative analysis that questions the verity of theories and assumptions that justify existing international development policy. In particular, evidence is presented that refutes the contention that demographic transition theory is viable in a resource-constrained world. Third, key obstacles to adopting population reduction policies are evaluated. Failure to understand and mitigate resistance to managed population reduction will confound any attempts to promote population reduction policies. Last, this paper puts forth avenues of further research to facilitate effective operationalization of population reduction strategies.

Sustainable development theory

The central goal of sustainable development is to ensure that expanding consumption levels within a society remain within the carrying capacity of the ecosystem upon which the population depends for sustenance (Paehlke 1995). Although emergent technology has a role in enhancing ecological carrying capacity and resource utilization rates (Postel 1994), inevitably, achieving global consumptive sustainability necessitates that a balance be established between the planet's ecological carrying capacity (the breadth and depth of resources that the ecosystem provides) and two ineluctably entwined variables – the population size and the per capita resource consumption rate. Figure 1 presents a conceptualization of the trade-off that exists between population and consumption levels when striving for sustainability in a world of finite resources. The options are: (1) high population levels coupled with lower per capita consumption, (2) low population levels coupled with higher per capita consumption or (3) a compromise between the two variables.

Technological bolstering

A number of progressive thinkers adhere to an ideological proposition that achieving a sustainable balance between per capita consumption and population levels can be bolstered by applying technology to improve resource

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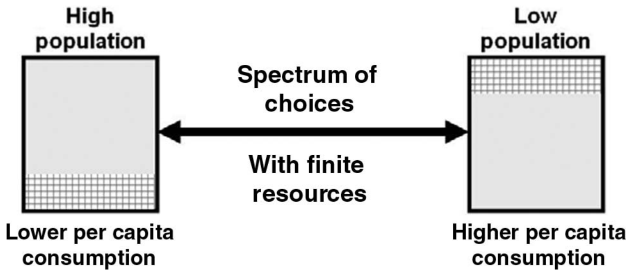

Figure 1. The sustainable development dialectic in a world of finite resources.

utilization (Hawken et al. 1999). Applied to the Figure 1, the role of technology in sustainable development is akin to enlarging the size of the box from which resources are drawn (Figure 2). Figure 2 graphically illustrates an important truth regarding the role of technology in sustainable development strategy: technology does not nullify limits to growth, it only expands the boundaries that limit growth. Moreover, for technology to be effective in this boundary expanding role, efficiency improvements must be realized throughout the product lifecycle. For example, improving gasoline mileage allows more automobiles to be driven for longer distances on a given quantity of gasoline. However, failure to proportionately improve emission control technology results in a higher level of emissions caused by the increase in automobile usage. This illustrates a critical flaw in logic regarding assertions that technology will facilitate the continuance of unfettered growth. Not all inputs and outputs associated with a product's lifecycle can (or will) be proportionately improved through technology.

History provides countless examples of technology failing to keep pace with unfettered population and consumption growth. Indisputably, technological progress in industrial efficiency has improved the financial well-being of the majority of citizens in industrialized countries (Simon and Kahn 1984). However, progress has being realized through unsustainable use of natural resources and exploitation of environmental sinks (Meadows et al. 2005). As the UN conceded in the Johannesburg Declaration, '*The global environment continues to suffer. Loss of biodiversity continues, fish stocks continue to be depleted, desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating, and developing countries more vulnerable, and air, water and marine pollution continue to rob millions of a decent life. Humanity is already past the point of sustainable development*' (UN 2002a). Given expectations of both continued population growth and increasing consumption (UNEP 2003), assertions that technology, which has historically failed to keep pace, is capable of mitigating higher levels of ecological stress reflect wishful thinking at best.

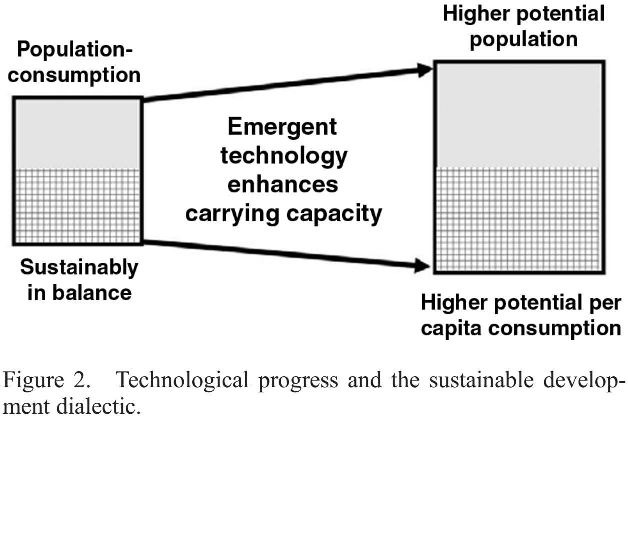

Figure 2. Technological progress and the sustainable development dialectic.

Share the wealth advocates

One might misconstrue the dialectic presented in Figure 1 as implying that all points on the spectrum between high population–lower consumption (left, Figure 1) and low population–higher consumption (right, Figure 1) are equally viable. This is not the case. Those who advocate that a sustainable balance involving high population–lower consumption is viable in the long run exhibit two fundamental flaws in reasoning.

First, regardless of consumption levels, eventually population levels must be controlled. At extreme levels of high population–lower consumption, increases in population foster famine, social strife and armed conflict. Indeed, at the risk of oversimplifying complex conflicts, these negative feedbacks are evident in some African nations. In short, failing to address overpopulation merely shifts the burden to future generations who will have a lower resource base to rely on for sustenance.

Second, regardless of economic status or nationality, the quest for economic betterment is a common goal (Sagoff 1988). Globally, national disparities in wealth exists in similar proportions, with the majority of GINI ratios ranging between 0.30 and 0.45 (Perkins et al. 2006). To illustrate, in 2004–2005, the top 5% of the population in India spent over 10 times more on daily consumables than did the bottom 5% of the population (Government of India 2006). Despite extensive poverty in India, few (if any) of India's affluent class have expressed a willingness to divide their material wealth amongst the poverty-stricken masses. The common quest for economic betterment is often masked by political rhetoric. Philosophically, the materialistic nature of humanity may be disagreeable to many (most of whom come from affluent ranks); however, it remains a global truth that economic betterment is a common human pursuit. Expecting individuals to sacrifice economic benefit (i.e. limit consumption or share accumulated wealth) to sustainably accommodate high levels of global population growth is unrealistic.

Invalidating the viability of achieving a sustainable balance involving higher population and lower consumption levels does not infer endorsement of excessive consumption practices. Conservation and more efficient use of resources represent economically effective strategies for abating environmental degradation that exist today. Improving consumptive efficiency also buys humanity more time to implement long-term sustainable policies.

However, improvements in resource utilization will be overrun by the growth in global population consumption that is anticipated (Cassils 2004). In the final analysis, only policies directed at development goals that favor a low population–higher consumption balance within sustainable parameters are sustainable in the long term.

The population challenge

The challenge of facilitating a low population–higher consumption balance within sustainable parameters is exacerbated by global population expansion. Although the exponential *rate* of expansion of the human population is *decreasing*, the absolute number of people on the planet is still dramatically *increasing*. In 1650, after nearly 1 million years of human existence, the world's population reached 500 million. Two hundred years later, the population doubled to 1 billion people (circa. 1850). It took only 80 years for the next doubling of population (2 billion in 1930), and then only 37 years to double again (4 billion in 1967) (Ehrlich 1968). The UN estimates that the world's population will reach 8 billion by 2025 (UNESCAP 2002). This means that the *rate* at which the world's population is expected to double again will decelerate to 58 years.

A slowdown in exponential growth rates should not obscure the main point – staggering levels of population growth have played a role in pushing aggregate consumption levels past the point of sustainability (UN 1992, 2002a). Furthermore, despite a decline in the population growth rate, population is still increasing. Our strained ecosystems will be obliged to sustain the consumption needs of population growth equal to one more China by the year 2025. Therefore, in the absence of a technological breakthrough that will allow humanity to economically identify and mine resources from other planets in the universe, population reduction is a requisite first step to restoring global sustainability.

Sustainable development strategy in practice

The current international economic development paradigm centres on catalyzing economic growth as the mechanism for facilitating progress in other developmental areas. The clearest explication of this development paradigm can be found in UN development blueprints such as Agenda 21 and the Millennium Development Goals. In both of these documents and related communiqués, references to technology transfer, economic development aid and improving resource utilization are prominent. Conversely, reference to population reduction is conspicuously absent from these international development strategies. For example, Chapter 5 of Agenda 21 is entitled 'Demographic Dynamics and Sustainability' and represents the chapter in which population reduction would logically be discussed. However, population reduction is not mentioned once in the entire chapter (UN 1992). Rather, the chapter uses what Porras (1993) called 'interpretatively vague UN-ese' to allude to the desirability of population reduction, provided it is in the interest of each nation to do so.

'This chapter contains the following programme areas:

(1) Developing and disseminating knowledge concerning the links between demographic trends and factors and sustainable development;
(2) Formulating integrated national policies for environment and development, taking into account demographic trends and factors;
(3) Implementing integrated, environment and development programmes at the local level, taking into account demographic trends and factors' (UN 1992, Paragraph 5–1).

Success of the current international economic development paradigm hinges on the validity of two critical assumptions. First, it assumes that aggregate increases in wealth in impoverished countries will trickle down to those living at the bottom of the economic pyramid in such countries. Second, it assumes that there are sufficient resources to support the expansion of aggregate global consumption to a level whereby poverty will be alleviated. Unfortunately, existing data casts serious doubt on the validity of these two assumptions.

Although it is intuitively appealing to think that increased wealth in a country will inevitably cascade down to the poorest ranks, actual data indicate that the cascading effect is a ponderous, inequitable process. For example, between 1981 and 2001, world GDP in current US dollars increased 260% from US$12.08 trillion to US$31.46 trillion (UN 2007). As Table 1 indicates, over the same period, while there has been progress in terms of reducing the number of people living in absolute poverty (earning less than US$1 per day), the number of people earning less than US$2 per day actually increased by an estimated 300 million people (Chen and Ravallion 2005). Moreover, the UN reports that the income gap between the richest and poorest countries is widening, not shrinking (UNDP 2006). In short, the assumption that people living in poverty at the bottom of the economic pyramid will expediently and substantively benefit from aggregate economic growth, may be less valid than it intuitively appears to be.

A prolonged global poverty alleviation battle amplifies the stress placed on the global natural resource base to support continued economic growth. Consequently, the assumption that there are sufficient global resources on the planet to support a prolonged period of unsustainable consumption is

Table 1. Population of developing countries living in poverty.

	1981	2001
Total population earning less than $1 per day	1.48 billion	1.09 billion
% of population earning less than $1 per day	40.4%	21.0%
Total population earning less than $2 per day	2.45 billion	2.74 billion
% of population earning less than $2 per day	66.7%	52.9%

Source: Chen and Ravallion (2005).

controvertible. The Global Footprint Network, which conducts annual global assessments comparing aggregate consumption to availability of global resources, fuels scepticism. In 1981, it estimated that fulfilling consumption demand utilized 90% of the Earth's biocapacity (the resources that nature annually regenerates). By 2001, consumption demand utilized 121% of biocapacity, which implies that global consumption was 21% beyond sustainable levels. As of 2006, consumption demand increased to 130% of biocapacity (Global Footprint Network 2007).

An overarching paradox that this analysis reveals is: if the United Nations which is one of the world's most conservative bureaucracies, acknowledges that humanity is consuming beyond sustainable levels (UN 2002a, Pt. 13), why are UN member nations continuing to resist the adoption of initiatives to reverse population growth trends?

Explaining the paradox

As this section endeavors to demonstrate, evidence indicates that this enigmatic, dubiously viable, international 'sustainable development' paradigm stems from a conflation of six elements:

(1) ***Empty world* economic theory applied to a *full world***: belief that elevated consumption levels to support economic growth can continue despite indications that ecological carrying capacities are being exceeded.
Supported and driven by …
(2) **Socio-economic pressures to expand population:** which represent daunting barriers for population reduction policies.
Justified through flawed interpretation of …
(3) **Demographic transition theory:** which posits that by reaching a stage of economic affluence, population contraction will naturally occur.
Bolstered by the exaggerated efficacy of …
(4) **Environmental economic theory:** applied in a resource-constrained world**,** which presents a false promise of achieving improved environmental well-being within the existing economic development paradigm.
Insulated from challenge by …
(5) **Limitations to scientific knowledge:** which prevents an accurate identification and assessment of risks associated with ecological overshoot.
Perpetuated by …
(6) **Herding behavior:** which hinders paradigm change despite compelling evidence that economic growth theory applied in a 'full world' produces net costs as negative environmental externalities escalate.

Empty world economic theory applied to a full world

The Earth is essentially a closed system. Humanity has access to a variable pool of resources that can be renewed (i.e. fish stocks, trees) and a fixed pool of resources that cannot be expeditiously renewed (i.e. iron, minerals). In the long term, even at low levels of consumption, achieving true sustainability is not possible because of the finite nature of non-renewable resources. Although true sustainability could theoretically be achieved by eliminating use of non-renewable resources and limiting consumption of renewable resources to those that are annually reproduced, a number of our technologies and critically important products are dependent on non-renewable resources as factor inputs (metals, plastics, minerals, fossil fuels, etc.). Accordingly, over time, even the smallest population base will gradually deplete the stock of non-renewable resources. However, in an 'empty world' of low population and abundant resources, the dent that human consumption makes in existing stocks of non-renewable and renewable resources is negligible. The depletion of non-renewable resources would, in most cases, require many millennia, and consumption of renewable resources would, for the most part, easily fall within sustainable limits.

An 'empty world' more or less describes the state of the planet in the late eighteenth century, when Adam Smith first published his cornerstone treatise of classical economic theory, *An Inquiry into the Nature and Causes of the Wealth of Nations*. In 1776, the global population was approximately 900 million people (UNESCAP 1999) – approximately 85% lower than it is now. During this era, economists such as Smith, David Hume and, later, David Ricardo put forth arguments that the economic betterment of society could be advanced through specialization of labor, concentration of factors of production and overall expansion of the economic base. Indisputably, these postulations were correct. The sustained application of growth-centered economic theory has vastly raised global standards of living (Perkins et al. 2006).

Continued prosperity under a growth-based economic system is dependent on one critical factor – the continued availability of resources to support growth. Continued availability of non-renewable resources such as fossil fuels or precious metals is most critical because, once non-renewable resources are extinguished, products that are manufactured from them cannot be made. Given the potential disastrous consequences to the global economy if innovation fails to create substitutes to replace exhausted resources, a modicum of prudence in natural resource management is warranted. There may come a day when certain minerals (for example) previously extinguished due to wasteful consumptive practices are discovered to be crucial for human development.

The availability of non-renewable resources is not the only constraint to economic growth. As mentioned earlier, even renewable resources are subject to finite limits. In a full-world, if consumption continues unfettered, the supply of renewable resources will eventually be surpassed by demand. At such a stage, further withdrawals of renewable resources will come from the renewable resource asset base, and the ability of the renewable resource asset base to produce further renewable resources will be diminished. This holds true in regard to both renewable resources and environmental sinks (i.e. the atmosphere, oceans, landfill

Table 2. Indications of progressive ecological degradation.

Worldwide about 420 million people live in countries that lack sufficient cropland to grow enough food to sustain the population (Worldwatch Institute 2003).
Human activity is 'very likely' the dominant cause of global warming and this may result in a permanent contraction in global GDP of up to 3% (Stern 2006; IPCC 2007).
Amplified concentrations of nitrogen and phosphorous caused by human activities could potentially alter plant and aquatic ecosystems on a scale at par with the perils associated with global warming (Worldwatch Institute 2003).
Since the 1960s the number of livestock has increased by 60% but so has the incidence of BSE, SARS and bird flu (Worldwatch Institute 2003).
Nobel laureate Edward O. Wilson estimates that as a consequence of widespread hunting practices and human encroachment on habitats, 20% of the world's animal and plant species could be gone by 2030 (Miller 2004). In 1992, over 1500 distinguished scientists (including a majority of the living Nobel laureates in the sciences) announced that one-third of all species now living may be extinct by 2100 (UCS 1992).
Primary tropical rainforests are disappearing at a rate that is estimated to be in excess of 140,000 km^2/year (Worldwatch Institute 2003). In the past 50 years, 'the world has lost a fourth of its topsoil and a third of its forest cover' (Hawken et al. 1999).
Wetlands which are vital bird habitats, marine life sanctuaries and oceanic purifiers have contracted by over 50% over the past century (Worldwatch Institute 2003).
Over 70% of the world's fish species are either fully exploited or stocks are being depleted (UN 2006).

sites, emission absorbing plants, etc.) that absorb waste from production and consumption practices (Thampapillai 2002).

Clearly, it is undesirable both from an environmental and an economic perspective to allow consumption to reach a level whereby the capacity of the planet to sustain further economic growth is diminished due to lack of natural resources or degraded environmental sinks. Therefore, an imperative question is, where does humanity now stand in terms of aggregate consumption and the planet's capacity to sustain increased levels of consumption? As the data in Table 2 indicate, humanity may already be closer to the full world scenario than desirable. The breadth and scope of data pointing to extensive environmental deterioration implies a widespread deterioration of the natural capital asset base. Such impairment challenges the validity of the assumption that the planet can sustain further aggregate increases in consumption of the degree necessary to alleviate global poverty. In short, the classical growth-based economic paradigm that worked so well in advancing the fortunes of industrialized countries in an 'empty' world is now being challenged to produce the same results in developing nations without the previously enjoyed benefit of unfettered access to environmental endowments. On the contrary, to restore consumption to sustainable levels and still alleviate poverty, economic growth must be achieved at the same time that a contraction in aggregate resource consumption is facilitated. This is clearly antithetical to prevailing theory given the positive correlation between economic growth and increased resource consumption (Perkins et al. 2006).

Although managed population reduction represents one way in which per capita consumption can remain the same while simultaneously reducing absolute demand on natural resources, there is a high degree of resistance toward population reduction for both economic and socio-cultural reasons. The next section examines these forces of resistance.

Socio-economic barriers to population reduction

Forces in opposition to population reduction strategies can be grouped into two clusters. First, from a macro-economic perspective, population growth is perceived as a stimulus for economic growth and fiscal prosperity. Second, from a socio-cultural perspective, some social artefacts hinder population reduction efforts while others actually promote population expansion. Policy initiatives aimed at reducing population will have to overcome these economic forces and emasculate deeply entrenched socio-cultural values.

Economic–political ideology and overpopulation

As alluded to in the previous section, neoclassical economic theory considers economic growth to be a catalyst for increasing affluence (Straubhaar 2003). A number of studies have demonstrated that in an 'empty world', a virtuous circle exists between economic growth and improvements in education, health and longevity (Perkins et al. 2006). Arthur Lewis (1955) summarized the benefits of economic growth in this way, 'the advantage of economic growth is not that wealth increases happiness, but that it increases the range of human choice'.

Generally, neoclassical economic growth models have treated population growth as a desirable outcome (enhanced factor of labor). The dominant neoclassical economic development models are largely based on two assumptions – growth is facilitated through either (1) accumulating factors of production (simplified as labor, capital and material inputs) or (2) making those assets more productive (Perkins et al. 2006). Accordingly, population growth has generally been viewed as desirable because population growth expands the labor force (in the long term) and this expands the productive capacity of a nation. Furthermore, under New Trade theory, population growth enables amplified economies of scale in production because population growth creates a higher level of consumer demand and provides the requisite level of labor in order to leverage further economies of scale (Hill 2007).

The exception to the generally benevolent view neoclassical economists have of increasing the population base relates to countries where there is high unemployment or extreme population growth. For example, Todaro and Smith (2003) acknowledge that overpopulation in some countries limits the amount of arable land to produce food for the populous. Furthermore, Perkins et al. (2006) point out that large family size makes it difficult for parents to finance the education of their children and increases the incidence of child mortality, as closely spaced births increase the health risks of pregnancy. However, even in circumstances of high unemployment or extreme population growth, the typical solution is to seek ways to expand other factors of production (capital) so surplus labor can be utilized (Todaro and Smith 2003). Generally, there would likely be little argument from traditional neoclassical economists that somewhat balanced growth of factors of production (labor and capital) is desirable.

From an industry perspective, population growth is also a desirable outcome. First and foremost, population growth increases the consumer base, and this means that prospects for revenue growth are increased. Second, population growth implies that some communities will become more densely populated; therefore, the labor pool from which industry draws workers will be enhanced (Cassils 2004) and so will opportunities to enhance specialisation of labor (Frank and Bernanke 2007).

From a political perspective, growth of any kind – including population growth – is often a sign of progress. Conversely, population decline is seen as a sign of economic weakness – a reduced ability to compete. As outlined earlier, population growth (more children) leads to expanded consumption, which, *ceteris paribus*, stimulates economic investment and job creation (Johnson 2004). Moreover, population growth portends higher potential tax revenues (or aid allocations). Accordingly, even in underdeveloped and developing economies with high levels of unemployment, politicians are more inclined to welcome population growth rather than population contraction.

To summarise, under the current neoclassical growth-centred economic paradigm, economic markets, industry and governments are all generally predisposed toward population expansion. A notable exception involves cases of extreme overpopulation, such as that experienced by China in the 1980s, where both environmental well-being and productivity were significantly threatened by overpopulation and the government was forced to implement population control policies to try and restore the balance (Jowett 1991). Unfortunately, in the absence of crisis conditions, such policies are rare.

Social artefacts and overpopulation

Fortunately for politicians, the economic–political forces in support of population growth are reinforced by social artefacts. Social artefacts are defined as 'any product of social beings and their behavior' (Babbie 2004). Aside from the predictable array of social and self-actualizing justifications that individuals may provide for wanting large families, there are equally valid socio-cultural justifications that in all respects hinder population reduction, and in some respects encourage population growth. These justifications include cost sharing, old age security, inheritance issues, male despotism and religion.

In rural communities, larger families imply more laborers for the fields (at some point) and that means that larger families can earn more while spreading the costs of living over a wider base of people (Li and Vernon 2003). This phenomenon represents a familial application of marginal benefit theory. As long as the revenue streams generated by each additional child exceed the sum of total variable costs for the child (i.e. food and clothing) plus opportunity costs associated with sharing living space, there is an incentive for families to have more children. In many impoverished societies where endemic diseases spawn high mortality rates, raising more children provides improved security for parents that they will be looked after when they become infirm. Large families serve as natural social security blankets in communities where welfare systems do not exist (Jowett 1991).

The desire for male offspring in many cultures fuels population growth. Given the *a priori* assumption that approximately 50% of newborns are female, it follows statistically that for each birth, half of the families that are intent on producing a male heir will be motivated to produce another child upon the birth of a female. Furthermore, half of these families will fail to produce a male on their second attempt. In other words, the quest for a male heir acts as a catalyst for population growth. Male despotism, particularly in impoverished countries, also adds to population growth pressures by undermining family planning efforts (UNFPA 2009). In extreme manifestations of this social artefact, high incidents of rape and associated childbirth add to the population control problem (Clayton 2004). Of more universal concern from a feminist perspective, tying women to the home to raise children is a method by which males can subordinate women both economically and intellectually, and this, therefore, is another catalyst for larger families caused by male despotism (King 1998).

In summary, despite the growing list of adverse ecological consequences of too many people consuming at an unsustainable rate, a high number of political, economic and socio-cultural forces help to perpetuate international development initiatives based on economic growth, which must be sustained through enhanced consumption of resources. The quantitative data presented earlier that ecological carrying capacities are being exceeded should at least foster a discussion on the wisdom of allowing population growth to continue. However, mainstream discourse has failed to materialize. One reason is that population concerns are somewhat allayed through a flawed interpretation of the demographic transition model.

Demographic transition theory: interpretative shortcomings

Demographic transition theory is not a singular theory put forth by one individual; rather, it is comprised of a series of postulations made over time by a number of researchers trying to explain what causes birth rates and death rates to change in different societies (Weeks 2008). Over time, some of the postulations have gained acceptance as general truths,

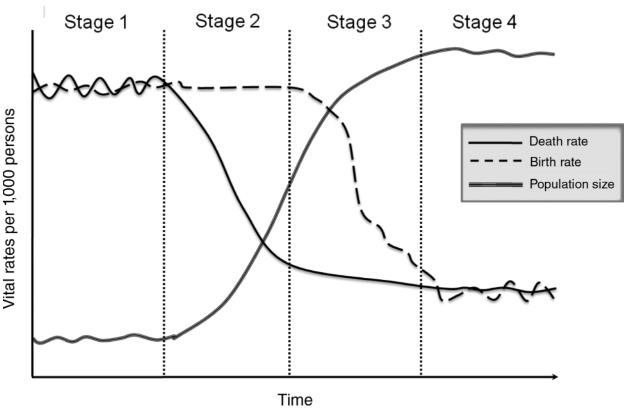

Figure 3. The stages of demographic transition.

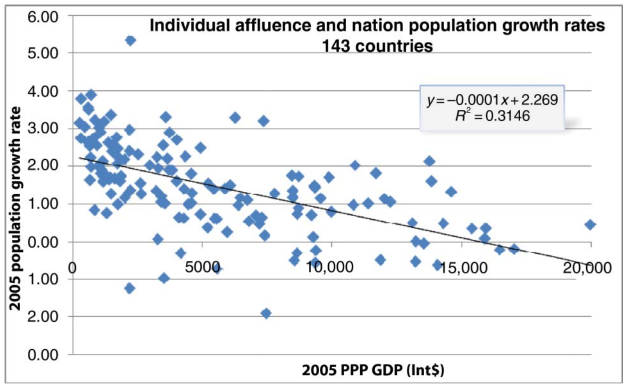

Figure 4. Level of affluence required to stabilize population. Source of data: World Bank Development Indicators (2008).

which in turn have led to the development of graphic models to illustrate the relationships; Figure 3 represents such a model. As Figure 3 indicates, primitive societies (Stage 1) are characterized by high birth and death rates, which keeps population in a state of homeostasis (population stability). Societies in Stage 2 benefit from medical and nutritional advances that significantly reduce mortality rates; consequently, the population skyrockets. Some African nations exhibit such characteristics. In Stage 3, a decline in the birth rate diminishes the population growth rate. A common explanation for this phenomenon stems from rational choice theory. Enhanced economic welfare increases the opportunity cost associated with large family sizes (Caldwell 1976). Most developing nations with increasing populations would be characterized as Stage 3 societies. Finally, in Stage 4, birth rates and death rates congregate at low levels and the result is a renewed state of homeostasis or even population decline (Lee 2003). This phenomenon is evident in industrialized countries such as Japan, Germany, Italy and Spain (Weeks 2008). Demographic transition theory is popular in policy circles because it makes intuitive sense and because there has been a limited degree of empirical support for the general trends exhibited in the model illustrated in Figure 3.

The demographic transition model appeals to advocates of economic growth-based international development strategies because many of the factors that facilitate reductions in mortality rates (i.e. improvements in medicine, health and nutrition) and birth rates (i.e. improvements in education, social welfare and female empowerment) are facilitated through economic growth (Perkins et al. 2006). Indeed, affluent countries with declining populations provide real-world support for such contentions. Unfortunately, there is a problem in applying demographic transition theory on a global scale – sufficient resources are required to support the inherent growth in consumption necessary to reach Stage 4.

Figure 4 presents a linear correlation between individual affluence (as measured by per capita GDP) and population growth rates for 143 countries which reported national per capita GDP (using purchasing power parity) of under $20,000 (international dollars) in 2005. Nations that reported national per capita GDP of over $20,000 (international dollars) were excluded from the analysis in order to minimize the confounding effects of immigration, which tends to be more pronounced in affluent nations. Figure 4 conveys two important insights. First, the trend line intersects zero population growth at $16,000 (international dollars). In 2005, the global average per capita GDP (in PPP) was $8662 (international dollars).[1] In short, under current consumption practices, average per capita affluence would have to uniformly double in order for global population stabilization to occur. If the Global Footprint Network is close in its assertion that global consumption currently utilizes 130% of biocapacity, it is highly unlikely that there are enough resources to support ramped up levels of consumption that would inherently accompany a doubling of affluence. Second, the coefficient of determination (R^2), which measures the percentage of population growth explained by increasing levels of per capita GDP, is 0.3146. Almost 68% of population fluctuation is caused by factors other than individual affluence. Even if there were enough resources to support elevated levels of consumption to support doubling of affluence, there is no guarantee that global population would stabilize.

In summary, evidence indicates that the apparent synergy between development strategies to increase global affluence and demographic transition leading to population homeostasis is untenable in a ‘full world’. There are simply not enough resources on the planet to support the level of growth in affluence necessary to achieve population homeostasis. Accordingly, in pursuing this untenable synergic response, the current international economic development paradigm is merely serving to amplify environmental degradation, which in turn exacerbates poverty.

Environmental economics

Over the past three decades, a number of enlightened economists have noted that the failure of many neoclassical economists to include the cost of environmental endowments (natural resources and environmental sinks) in the economic system results in undervaluation of costs associated with economic activity, which in turn catalyzes excessive consumption (Costanza et al. 1997; Thampapillai 2002). In response, the notion of valuing environmental

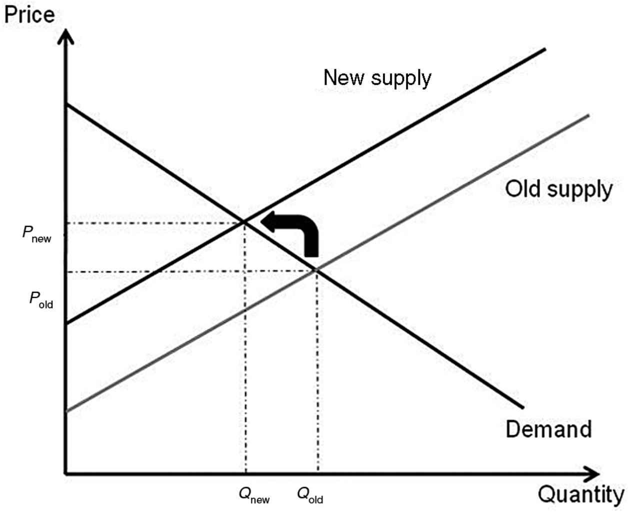

Figure 5. Reduced consumption as a result of valuing environmental endowments.

endowments has been advanced as a solution to deterring excessive consumption. The theoretical premise is that by placing a price on environmental endowments (i.e. water extracted from a stream, pollution assimilation services provided by the atmosphere, etc.), supply–demand equilibrium for a given economic activity will shift upward and to the left on the classical supply and demand chart – from P_{old}/Q_{old} to P_{new}/Q_{new} in Figure 5.

Theoretically, the additional funds collected for the environmental endowments could be used to bolster renewable endowments, where possible, or finance research into substitute resources, in the case of finite endowments. For proponents of the current international economic development paradigm, environmental endowment valuation presents intriguing possibilities for resolving environmental degradation because it is an approach that can be applied to the existing economic development framework. Accordingly, talk of green taxes, cap and trade systems and green 'superfunds' are increasingly prevalent in economic policy circles. In practice, environmental economic theory has been plagued by disagreement over optimal approaches to valuation of environmental endowments and dissent over policy approaches to operationalizing environmental costing. The reader is directed to Turner et al. (1994) for a critical discussion on valuation techniques. Likewise, Tietenberg (2003) provides an overview of different policy instruments for managing surcharges on environmental endowments. Despite lack of consensus over applied approaches, there is some truth to the assertion that any attempt at valuing environmental endowments is better than no attempt at all (Costanza et al. 1997). In the short term, assigning any significant value to the use of environmental endowments will induce more conservative consumption. Unfortunately, in a 'full world', debates over suitable valuation techniques or implementation policies are cosmetic challenges compared to the overall threat to economic well-being that accurate valuations of environmental endowments pose.

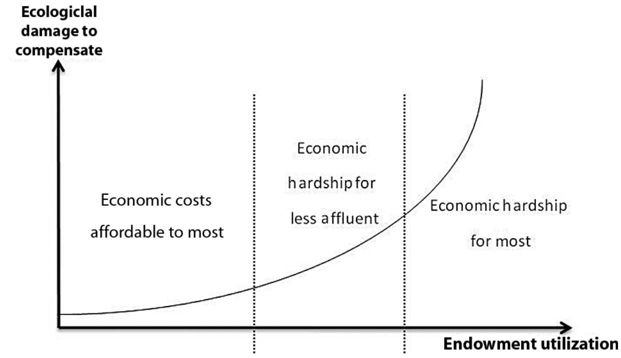

Figure 6. Environmental endowment valuation from empty to full worlds.

Figure 6 presents a conceptualization of three phases of economic impact caused by full environmental valuation as carrying capacity (exhaustion of the endowment) is approached. In an 'empty' world, where resources are plentiful, the social marginal cost of utilizing one more unit of an environmental endowment is negligible. Consequently, even if environmental endowments were fully valuated, the environmental surcharge could be borne by most (left, Figure 6). As resources become scarce or environmental sinks become saturated, the marginal cost of utilizing an additional unit of the environmental endowment rises significantly (middle, Figure 6). Full valuation of the environmental endowment at this stage would begin to pose economic hardship on less affluent citizens. The scrubbing of coal, which is a critical resource for energy generation in many countries, illustrates this point. One study indicates that by including full social costs (i.e. health problems caused by emissions, contribution to global warming, etc.) associated with using scrubbed coal to generate power, the cost of energy derived from this resource would quadruple (Sovacool 2008). Consumers in affluent societies would grumble about such cost increases; however, the greatest encumbrance would be experienced in impoverished societies, where the cost of fuel for heating and cooking represents a much larger percentage of the average person's budget.

As resources reach the brink of exhaustion or environmental sinks near saturation point, the marginal social cost of utilizing one more unit of environmental endowment imposes enormous social costs on society (right, Figure 6). Accordingly, at these extreme levels of utilization, a full valuation of the scarce environmental endowment would result in end-costs that few could afford. So far, extreme cases of environmental endowment degradation have been largely limited to local or regional problems involving renewable resources (i.e. rivers or lakes that have become saturated with pollution). In such instances, the government has been compelled to intercede and prohibit further discharge of effluents. However, if this state is reached with finite resources that are used as vital inputs for supporting economic growth, government prohibition may not be an option. Under such a scenario, at best, humanity would invent a substitute that did not utilize the scarce resource; thus, end product prices would not be significantly affected. However, in a worst-case scenario, no substitute would be found and those who could not afford to pay the higher cost for the scarce resource would be forced to go without. Ominously, as more resources become scarce, the probability that affordable substitutes can be found for all scarce resources diminishes.

This discussion on the hazards of applying environmental economic principles in a 'full world' should not be misconstrued to imply that environmental endowment valuation has no role in promoting sustainable consumption. Indeed, applying such principles to the consumption of environmental endowments in affluent countries would help slow the pace of depletion. However, even if such policies were applied only to affluent countries, economic reverberations would be felt both domestically and overseas. Domestically, governments adopting such policies would be likely compelled to initiate a series of transfer payments to citizens in the lowest economic quintile in order to avert disproportional economic hardship. In impoverished nations, the cost of imports from affluent countries would increase (due to higher resource costs) and the volume of exports to affluent countries would decrease as global supply and demand contracted in response to higher resource costs. Impoverished nations would likely be left to their own guiles to deal with these impacts.

In conclusion, environmental economic valuation appears inherently fair because environmental valuation serves as a direct tax on consumption: heavy consumers pay more. Meanwhile, population reduction strategies invoke images of heavy-handed government meddling in an issue that is a fundamental human right. In reality, both perspectives are exaggerated. Environmental valuation is not perfectly equitable because high levels of consumption by affluent societies disproportionately cause the scarce conditions that give rise to higher environmental valuations. Similarly, population reduction strategies do not have to be heavy-handed. For example, improving education and enhancing employment opportunities for females are two effective strategies for lowering birthrates.

A closer reflection of reality is that in 'full world' economics, environmental economic principles and population reduction strategies represent a requisite one-two punch. First, environmental economic principles can be 'selectively' applied to expeditiously cool off consumption of environmental endowments under stress (i.e. atmospheric saturation of greenhouse gases, depletion of tropical rain forests by the lumber trade, etc.). Selective application would minimize the economic threat posed to impoverished societies discussed earlier. Second, within a generation, effectively implemented population reduction strategies would rein in global consumption to a sustainable level without adversely affecting per capita consumption.

Environmental degradation and scientific uncertainty

Regrettably, motivation to examine new development approaches in a 'full world' is dampened by disagreement over whether or not we truly live in a 'full' world. Scientific uncertainty stems from the highly complex, dynamically integrated, adaptive nature of our global ecosystems. There are numerous influential variables (highly complex), which are interrelated and evolve in response to changes in other variables (dynamically integrated) and which can generally adapt in response to exogenous forces (adaptive systems) (Beinhocker 1999).

A cursory examination of the global warming dilemma serves as a practical example of how the fusion of these three characteristics – complexity, dynamic integration and adaptability – complicate understanding of the severity of global environmental problems. For over two centuries, enormous quantities of greenhouse gases stemming from human activities have been emitted into the atmosphere. This is a result of a broad spectrum of activities that produce carbon dioxide (i.e. fossil fuel combustion), methane (i.e. agricultural activities), nitrous oxide (i.e. automobile emissions, fertilizers), chlorofluorocarbons (CFCs) and hydroflorocarbons (HCFC) (i.e. air conditioners), halons (i.e. fire extinguishers) and carbon tetrachloride (i.e. cleaning solvent). For decades our global atmospheric system was able to assimilate these exogenously induced pollutants without any significant repercussions. However, increasingly high concentrations of these gases eventually exceeded assimilation capacity. This has led to accumulating concentrations of greenhouse gases in the atmosphere. Thus, our atmosphere has begun to absorb more heat and the global atmospheric temperature has started to increase (i.e. one environmental variable changes).

Atmospheric warming is the catalyst of a huge array of cause and effect relationships. For example, weather patterns are altering, polar ice caps are melting, ocean currents are shifting, and agricultural conditions are changing. Each of these changes will in turn catalyze changes in other environmental variables (i.e. the viability of some fish habitats will be effected by shifting ocean currents, animal migratory patterns will be altered as weather patterns change, etc.). Furthermore, changes in these environmental variables will catalyze changes in other environmental variables. All these cascading changes are indicative of the complex interplay that exists amongst the numerous variables in any ecosystem (Miller 2004). Needless to say, predicting the impact of a change in one variable on the other variables in such a complex system is highly speculative given current scientific understanding. Inadequate scientific understanding is exemplified in relation to global warming (Stern 2006). Until very recently, there was considerable dissent over the interpretation of scientific climate change data. Some critics attributed the global warming trend experienced in recent times to a natural cycle of temperature fluctuations in evidence throughout recorded history (Miller 2004). Only recently has international consensus consolidated to the point where there is now general agreement that global warming is due to human activity (IPCC 2007). Yet there is still widespread disagreement over the degree of impact that global warming will have on our planet (Lindzen 2006; IPCC 2007).

When viewed from a broader ecological perspective, global warming should be viewed as a symptom of humanity's excessive consumption, which is stressing the carrying capacity of our ecosystems. However, as climate change mitigation negotiations now demonstrate, the absence of irrefutable science often leads to the maintenance of business as usual patterns of consumption until symptoms become undeniably obvious. As Kuhn (1962/1996) points out, there appears to be a tipping point where the body of new evidence becomes sufficient to cause a paradigm change, but until that point is reached, there will continue to be vested interests which prevent a migration from status quo. This collective resistance has been referred to as herd behavior (Rook 2006).

Herd behavior and resistance to change

Herd behavior is a risk mitigation technique. Animals and people herd together because there is safety in numbers. Corporations have been known to mimic strategic activities of competing firms to defend market share (Bartlett et al. 2003; Rook 2006). Many professional investors adopt trading strategies that involve responding expeditiously to market trends (Harford 2006). For economists and policy makers, herding behavior is manifest in defence of the current international economic growth-centered development paradigm. Three forces stimulate this behavior.

The first force is the track record of success attributed to the current paradigm. Neoclassical economic theory has spearheaded the highest level of global development success in the history of humanity. According to economic historian Angus Maddison (2003), global economic growth was practically nil between 1 AD and 1000 AD. Moreover, between 1000 AD and 1800 AD, annual growth averaged a miniscule 0.05%, which means that it took more than eight centuries for world income to increase by 50%. However, thanks in large part to industrialization guided by modern economic theory, global economic growth took off in the nineteenth century and has averaged 1.2% since 1820 (Maddison 2003). Accordingly, despite evidence of widespread depletion of environmental endowments, many economists and policy makers firmly believe that the economic recipe used for past success is still applicable in today's 'full world' (Simon 1981).

The second force in support of herd behavior is that economists and policy makers covet stability. Like an ecosystem, the economic system is a complex, adaptive system. Numerous influential economic entities (financial institutions, industry, services, etc.) are interdependent and are dynamically affected by changes occurring within the system. The extent of interdependency fuels complexity and stymies predictability (Beinhocker 1999). Accordingly, the prospect of inducing a massive change, such as integrating population reduction policies into the economic system, threatens the stability of the system. Despite evidence that population reduction is now a necessary evil, population contraction that is not counteracted by policies to facilitate an aggregate increase in affluence could push the global economic system into a prolonged recession. This is a risk that economists and policymakers would prefer to avoid if possible.

The third force supporting herd behavior is scientific uncertainty, elaborated upon earlier. Lack of scientific certainty over maximum ecological carrying capacity and a smattering of successes in overcoming severe environmental problems in the past have emboldened entrenched interests to defend the status quo. No reputable economist would deny the existence of environmental problems. However, many would argue against drastic changes in development strategy because policy instruments already exist that could correct environmental market failings (i.e. command and control mechanisms – prohibitions and regulations – environmental taxes, etc.) (Tietenberg 2003). In the absence of incontrovertible proof (i.e. global ecological disaster) that ecological problems are irresolvable with current policy instruments, there will be continued resistance to population reduction initiatives.

In conclusion, given the tendency of the economic herd to rally around neoclassical economic growth theory, it should come as no surprise that when the United Nations announced that, 'Eradicating poverty is the greatest global challenge facing the world today' (UN 2002b), the emergent solution was based on a strategy that has worked before – encourage economic growth. At the core, the approach to poverty alleviation as espoused by Agenda 21 centres around a strategy of fostering economic growth supplemented by wealth redistribution (Mestrum 2003). Under the current development paradigm, population control policies, which are essential for achieving true sustainable consumption, are perceived as being in conflict with poverty alleviation efforts. This is because a shrinking population base implies a reduction in production economies of scale and overall consumer activity. In such a scenario, the implication is that the global economy would retract and poverty would increase. This is a false premise because per capita affluence is enhanced through productivity increases not through aggregate increases in consumption (Porter 1990). Nowadays there are very few industries that would benefit through increased economies of scale from continued population growth (Grant 2005).

Global population policy

The result of this confluence of forces is an unsettling trend of support for more (albeit controlled) population growth. According to the UN's World Population Policies 2003, 'Nearly half of developed countries view their population growth rates as too low. Almost 40% of developed countries have adopted policies to raise their population growth' (UN 2003). Meanwhile, in underdeveloped and developing countries, where ecological degradation is more severe, many countries are beginning to recognize the need to *balance* population and economic growth to try and mitigate the environmental damage caused by unfettered industrial growth. Policy makers in over half of the countries in the less developed regions consider their state's *rate* of population growth to be too high. Notably, leaders in over three-quarters of Africa's nations view their respective national population growth rates as too high (UN 2003). Similarly, in developing countries, the prevalent trend is for policies of continued population growth although at lower rates of growth (WRI 2002).

To summarise, in industrialized countries where population growth rates are sinking to replacement levels, policies are beginning to emerge to encourage reproduction. Australia, France, Japan, Singapore and Germany all provide incentives to citizens for having more children (Longman 2004; Ehrlich and Ehrlich 2006). In developing countries, where environmental deterioration is seen as a hindrance to economic growth, population growth rates are decreasing, but in most cases replacement levels are still exceeded; and in aggregate, population in developing countries will increase. For example, it is estimated that by 2025, China, India and Indonesia alone will add over 500 million people to the planet (WRI 2002). Meanwhile, underdeveloped nations are still suffering from rudimentary socio-cultural forces that foster rapid population growth. Rampant population growth in these countries is widely considered problematic (UN 2003). For example, the population of Sub-Saharan Africa is expected to rise by 500 million in the next 20 years despite acknowledgement by leaders in that region that population growth is a problem (WRI 2002). The aggregate effects of these trends is a projected increase in global population over the next 20 years of 2 billion people (WRI 2002).

The rocky road ahead

This paper has presented evidence that global natural resources and environmental sinks are insufficient for sustaining the elevated levels of consumption that are inherently linked to the requisite levels of economic growth necessary to alleviate global poverty. Yet, despite mounting evidence that humanity is already consuming at unsustainable levels, the international economic development community continues to unquestioningly pursue economic development strategies that will fail to achieve the intended goal of poverty alleviation and exacerbate already severe environmental problems. As Jeffery Sachs recently summarized, 'if we already are on an unsustainable trajectory and yet China, India, and large parts of Asia are successfully barrelling ahead with rapid economic development at an unprecedented rate. We are asking our planet to somehow absorb a many-fold increase of economic activity on top of an already existing degree of environmental stress that we've never before seen on the planet' (Sachs 2007). As this paper demonstrates, population reduction is an essential prerequisite for the current international economic development approach to achieve widespread poverty alleviation. However, a considerable amount of further research is necessary if population reduction initiatives are to be effectively integrated into the current neoclassical growth-centered development paradigm. The nine research questions outlined below highlight crucial challenges that must be overcome if population reduction strategies are to be effectively implemented:

(1) How can population reduction policies avoid catalyzing global economic contraction that would exacerbate poverty in the short term?
(2) What strategies would be most effective for overcoming the socio-economic barriers introduced in this paper?
(3) How can environmental economic principles be applied in a 'full world' without catalyzing global economic contraction?
(4) What would be needed to create an online central data warehouse that accurately reports environmental data and provides scientific analysis that is free of vested-interest bias?
(5) What strategies would be most effective for eroding the herd behavior outlined in this paper?
(6) What are the main socio-cultural problems that can be expected as a result of a managed global population reduction strategy?
(7) What is the optimal level of global population?
(8) What policy tools would most effectively facilitate population reduction?
(9) What social welfare structures would best help societies with contracting populations cope with the ill-effects associated with population momentum?

Regrettably, history has shown that dominant social paradigms change very slowly because they are often founded upon consensus opinion dominated by influential thinkers who will resist challenges to the dominant paradigm (Pirages 1982). As Kuhn (1962/1996) observed, paradigm change occurs only 'after a pronounced failure in the (*sic*) normal problem solving activity'. This paper reluctantly endorses a perspective that existing scientific evidence of ecological overshoot is compelling, but not incontrovertible. Therefore, further ecological disaster will likely be necessary before the current international development paradigm is rejected. In the meantime, the epistemological stance that this paper takes is that prior to paradigm shifts, challenges to the dominant paradigm come from various intellectual communities, which introduce contradictory data and perspectives that proponents of the dominant paradigm are increasingly hard pressed to refute (Couvalis 1997). This paper symbolizes such a challenge. It is hoped that the challenge put forth is compelling enough to encourage further research into the questions outlined above.

Rather than viewing the Moai statues of Easter Island as symbols of a past society consumed by avarice, we should instead view these statues as omens of humanity's overall fate should we decide to continue along our path of unsustainable consumption and overpopulation of the planet. Optimistically, global warming may be the crisis that is needed to institute the level of inward retrospection needed to facilitate a critical review of existing economic development strategy. The question is, how severe do the effects of global warming have to get before humanity understands that global warming is not an energy problem, but rather a symptom of a much deeper flaw in humanity's conceptualisation of sustainable development?

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Note

1. Source: World Bank Development Indicators. Online: www.worldbank.org. Accessed 12 April 2009.

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