NPG Forum

An Essay on a Sustainable Economy

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Foreword: Since NPG was founded over a quarter century ago it has argued that the most important task facing the human race is to create an economy that would be sustainable indefinitely, and afford an adequate standard of living for all the world's people. But to create such a sustainable economy would be impossible without a smaller world population than the 3.8 billion existing in 1972 when NPG was founded.

Until now we have never attempted to define what size global economy would be sustainable, but we feel that an attempt to do so, despite the obvious difficulties of such an undertaking, is long overdue.

The central purpose of this paper is to try and address the following two questions:

1. What is the optimal size of a global economy that would be sustainable indefinitely, and afford an adequate standard of living for all?

2. What size world population would be necessary in order to create such a sustainable global economy?

Summary: *A short definition of sustainability is the management of environmental and resource systems so that their ability to support future generations is not diminished. The term "sustainable development" is more difficult to define, and has given rise to widely different and at times conflicting interpretations. For environmentalists and conservationists it has come to mean the process of development toward a truly sustainable economy that respects environmental and resource limits. But too often others use the term sustainable development as a synonym for sustainable economic growth.*

In contrast to that view, many scientists believe, as do we at NPG, that sustainable economic growth is an oxymoron and self-contradictory. ***Adherents of this view point out that, since the economy is a subset of our non-growing ecosystem, development, in order to be sustainable, can only mean qualitative change without material growth.***

Given the damage to our environment and resources resulting from the present scale of human economic activity, the argument against further material economic growth appears to be unassailable. The need now is to go beyond the debate on growth vs. non-growth and address the fundamental question: what scale or size of global economic activity would be sustainable indefinitely? The preponderance of evidence clearly indicates that the global economy, to be sustainable, must be far smaller than it is today.

Population size is the crucial variable in achieving a sustainable economy. Only with a sufficient reduction in population would it be possible to envisage a decent standard of living for all, within the constraints of the world ecosystem.

What size world population would allow the creation of a sustainable economy? ***We at NPG believe that it is in the range of 1.5 to 2 billion, based on the assessments of the major population and resource scientists most concerned with the limits of economic growth.*** *That was the level of world population as recently as the first decade of the 20th century, before the pressure of numbers had generated the environmental damage now visible.*

We recognize that a specific target can never be more than a rough approximation, given the uncertainties, value judgments, and changing human preferences involved. ***Nevertheless we are convinced***

that a specific population target is the essential prerequisite for action. The only alternative is to take refuge in vague warnings and exhortations, as almost all population and environmental organizations do, and consequently accept aimless drift. *If we wait for absolute and likely unattainable precision before taking action on population, we will be forever locked into inaction on the most critical issue that will shape the human future.*

But far from the 1.5 to 2 billion we believe would be sustainable, if present trends continue our present world population of six billion is projected to nearly double in the 21st century, with most of the growth in the developing countries. ***But a massive reduction in the size of world population will require a massive reduction in the population of every country in the world, developed and developing alike****. That in turn will require the achievement of fertility rates well below the replacement level of roughly 2.1 children per woman. Such levels have already been reached by most countries in Europe, some of which are already experiencing population decline.*

If almost no women had more than two children, the world's fertility rate would drop well below the replacement level because some women choose to have only one child, or remain childless. ***For at least the next two generations the two-child maximum family must become the world's norm.***

Almost everyone concurs that sustainable development is desirable, but its meaning remains somewhat vague, and subject to widely divergent interpretations. As Professor Herman Daly has pointed out (Daly, 1996), it is a term that everyone likes, but nobody is sure of what it means. The latest trendy term, "smart growth" has the same appealing ambiguity.

The term "Sustainable Development" first came into prominence with the publication of The Brundtland Report *Our Common Future* (World Commission on Environment and Development, 1987). The report was tremendously influential in popularizing the concept. Regrettably, the report did not distinguish between growth in physical consumption and investment and qualitative development without growth, and never faced up to the inherent contradiction between sustainability and unlimited material growth.

Indeed the report begins with a clear call for economic growth: *"What is needed now is a new era of economic growth — growth that is forceful and at the same time socially and environmentally sustainable."* The Report even foresaw a five to tenfold growth in world GNP (about $30 trillion in 1996) in 50 years to meet the minimal needs of the world's poor, without ever explaining how such enormous growth could possibly be sustainable.

Perhaps the essence of the Report's message is captured in the following sentence: *"The Commission's overall assessment is that the international economy must speed up world growth while respecting the environmental constraints."* Prudently, the Commission refrained from attempting to explain how the two conflicting goals could possibly be reconciled.

The apostles of unlimited economic growth have endeavored to cloak their views in an aura of respectability by treating "sustainable development" and "economic growth" as being synonymous. The following quotation from the President's Council on Sustainable Development (1995) is a good example:

> *"A sustainable United States will have a growing economy* (underscoring added) that provides equitable opportunities for satisfying livelihoods and a safe, healthy, high quality of life for current and future generations. Our nation will protect its environment, its natural resources base and the functions and viability of natural systems on which all life depends."

It seems clear, therefore, that to the President's Council "Sustainable Development" means "Sustainable Economic Growth." The problem with the latter term, of course, is that it is an oxymoron, a contradiction in terms, since no material growth on a finite earth can possibly be sustainable indefinitely (Grant, 1997).

An Opposing (and realistic) View

There is a completely opposite view of the meaning of "sustainable development" that guides NPG. **Economist Herman Daly, an originator of this view, has defined sustainable development as development without growth beyond environmental carrying capacity, where development**

means qualitative improvement and growth means quantitative increase (Daly, 1996).

Professor Daly writes, "The power of the concept of sustainable development is that it both reflects and evokes a latent shift in our vision of how the economic activities of human beings are related to the natural world — an ecosystem which is finite, nongrowing, and materially closed. The demands of these activities on the containing ecosystem for regeneration of raw material "inputs" and absorption of waste "outputs" must, I will argue, be kept at ecologically sustainable levels as a condition of sustainable development. This change in vision involves replacing the economic norm of quantitative expansion (growth) with that of qualitative improvement (development) as the path of future progress" (Daly, 1996, p.1).

Professor Daly goes on to say that the principal property of sustainable development is that the scale of the economic subsystem is within the carrying capacity of the ecosystem. We fully agree with that statement.

A Sustainable Economy

A great deal of confusion might have been avoided if The Brundtland Report had chosen as its theme "a sustainable economy," rather than "sustainable development."

The goal of a sustainable economy would have focused the debate about sustainability on the crux of the problem confronting us: how to create a global economy that can be sustained by the earth's resource base indefinitely, with an adequate standard of living for all.

We propose that the unattainable goal of sustainable economic growth be abandoned and replaced with a specific and unambiguous goal: a sustainable economy. A necessary condition of a sustainable economy is sustainable resource use (Lachenbruch, 1997).

A Steady-State Economy

Since growth in the annual throughput of energy and materials cannot be sustained in our finite world, a sustainable economy must, of necessity, be a steady-state economy, characterized by a zero rate of material growth. Once it becomes generally accepted that material growth in a finite world cannot be sustained, then the goal of a steady-state economy should become widely recognized as our only viable option.

Attainment of a non-growing, steady-state economy, however, is only part of the solution. We also need to recognize that the present size of our global economy (which is a subset of our global ecosystem) burdens our ecosystem far too much to be sustainable indefinitely. Therefore, merely halting economic growth at the present level of economic activity would, at best, be only a necessary first step. **We would need thereafter to reduce the size of the global economy to a sustainable level and then stabilize it there.**

As a first step in that direction we need to decide on two critical parameters:

1. The level at which a global economy (defined as the annual throughput of energy and materials) would be sustainable, and set that as our goal.

2. The conditions that would enable us to reach that goal, which would include first, and most importantly, defining what size global population would be required. Population size is crucial. All other considerations such as levels of technology and per capita consumption being equal, our impact on our environment is a function of numbers.

To be sustainable indefinitely, a steady-state global economy would have to meet the following criteria, as set forth by Daly (1990):

Output rule: Waste outputs are within the natural absorptive capacities of the environment (i.e. nondepletion of the sink services of natural capital).

Input rules: (a) For renewable inputs, harvest rates should not exceed regeneration rates (nondepletion of the source services of natural capital). (b) For non-renewable inputs the rate of depletion should not exceed the rate at which renewable substitutes can be developed.

Those are indeed rigorous criteria, but it would be difficult to argue that sustainability could be achieved with anything less demanding. Clearly, our present global economy does not meet those criteria. The evidence is overwhelming that the present level of world economic activity cannot long be sustained without causing permanent and irreparable damage to the earth's natural systems that make economic activity possible.

Global warming, the thinning of the ozone layer, acid rain, soil erosion, the loss of wetlands, deforestation, desertification, the disappearance of millions of plant and animal species, the problems with the disposal

of solid, toxic and nuclear wastes, the depletion and pollution of underground aquifers, the impending exhaustion of world oil supplies; all these and more support that assertion.

There is already a scientific consensus that our present path will lead to disaster. In February 1992 the National Academy of Sciences and the Royal Society of London issued a joint statement warning that: ***"If current predictions of population growth prove accurate and patterns of human activity on the planet remain unchanged, science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world."***

If the present size of the global economy (the annual throughput of energy and materials) is not sustainable, then what size would be? The preponderance of evidence indicates that it would be substantially smaller than its present size. The direction we need to move in, therefore, is clear, even if at the present time a specific target cannot be defined with scientific precision.

What is needed is a negative rate of physical economic growth (i.e. throughput of materials and energy and output of waste and pollution) until such time as the global economy has been reduced to a size that can meet Daly's criteria.

The Nature of Proof

A scientifically precise calculation that would pinpoint with absolute certainty a sustainable size for either the economy or for population may well be unattainable. In an infinitely complex and evolving world and society there are simply too many interlocked and frequently unquantifiable variables.

Moreover, the current accounting systems for measuring national and global gross product obscure rather than encourage the needed precision, failing to account for the ongoing depletion of natural capital. Adoption of environmentally aware accounting systems is essential to measuring progress toward true sustainability.

Fortunately, we do not need scientific precision before acting. If we wait for absolute proof before adjusting the economy and population to the earth's limits, we will be forever locked into inaction on the major issues that will shape the human future. In most social and political areas we must make every day decisions based on imperfect knowledge, while applying the rule of prudence. The same holds true for economics and population.

Population - The Key Variable

Without a gradual but drastic reduction in the size of world population a major reduction in the size of the global economy would be impossible. Our present world population of six billion is still growing rapidly by about 80 million each year. It is projected to reach 10-11 billion before the end of the 21st century, although rising mortality rates may well prevent growth of that magnitude from being realized. We at NPG have long believed that a sustainable world population size is in the range of 1.5 to 2 billion, and that we should look to scientists, in particular to biologists and ecologists, for the most reliable estimates of the optimum size of world population.

Cornell University Professor David Pimentel, and his collaborators, have argued convincingly that an optimal and sustainable world population would be no greater than 1.5 to 2.0 billion (Pimentel, Giampetro, and Bukkens, 1998).

Their arguments can be briefly summarized as follows: The natural resources needed to sustain human life — ample fertile land, water, energy, forests and diverse natural biota — are finite. Population growth is reducing their per capita availability, and forcing greater reliance on diminishing fossil fuels. Trade and technology have masked these natural limits, but cannot compensate for the shrinkage of natural resources per capita.

Overexploitation of the earth's natural capital is causing what Pimentel terms a "hypercycle:" rising fossil energy inputs yield progressively fewer resources. Top soil is lost 30 times faster than it is replaced. Fresh water sources are overdrawn and degraded. The myriad species which serve human life are disappearing at the rate of 150 a day. The planet's inability to process the waste products of mass consumption of fossil fuels results in acid rain and global warming.

Our unsustainable culture of growth, Pimentel states, requires recognition of harsh limits. Population size must be consistent with environmental constraints. The higher the standard of living the smaller the population size that can be safely maintained. Technology may ameliorate, but it cannot prevent, environmental collapse. The human population, already excessive, is rapidly damaging the life prospects of future generations. Pimentel, backed by other scientists, sets the optimum population for a sustainable earth, with existing technology and an adequate standard of living, at no greater than 1.5 to 2.0 billion.

The crux of the matter is this: in order to know what policies need to be put into place we need to know not only the direction in which we should be heading, but we also need to have as precise an idea as possible of the approximate extent of the changes needed, a notion of the order of magnitude.

In any event, at best it would require more than a century to reduce world population to within a range of 1.5 to 2 billion, (by reducing fertility, temporarily, to well below the replacement level). There would be, therefore, ample time to do further research with regard to optimum population size, to take into account advances in technology, and to make any midcourse corrections believed to be desirable.

Unless, however, we can develop a consensus now on a specific numerical target or goal for an optimum world population we will continue our rapid growth toward a world population size that will almost surely bring on an economic and ecological disaster. **If we are unable to stabilize world population at a level far lower than today's, the result will be human misery and suffering on a massive scale.**

Only by achieving a far smaller world population can we have any hope of eliminating forever hunger and poverty, and of creating a society that will be sustainable indefinitely in a sound and healthy environment, with a base of material prosperity that will minimize human suffering and allow civilization to flourish.

We also need, of course, to find more efficient ways to produce goods and services so that the input of materials and energy and the output of pollution per unit of production is reduced as much as possible. But no combination of efficiencies now in sight would obviate the need for a drastic reduction in the size of world population. That is the indispensable condition, the *sine qua non*, of a sustainable economy.

How to Get There from Here

How could we possibly go about the daunting task of halting and then reversing the growth of world population so that it could eventually be stabilized within a range of 1.5 to 2 billion? Barring a disastrous rise in mortality, a reversal of population growth would require a level of fertility substantially below replacement level (an average of 2.1 children per woman).

If our goal is to halt and reverse world population growth until world population can, after an interim period of population decline, eventually be stabilized at a sustainable level, then a below replacement level of fertility would be required for both the developing and developed countries of the world (including, of course, the United States).

We need a specific goal or target for fertility just as we need a specific target for world population size. I suggest that a fertility of 1.5 is needed for at least several decades in order to halt and reverse world population growth. As already mentioned, that level of fertility could be reached if almost no women had more than two children, since many women voluntarily have only one child, or no children at all.

In a few European countries today the level of fertility is below 1.5 and in those countries fertility needs to be increased to that level. Extremely low fertility (below 1.5) should be avoided because of its disruptive effects on age structure, and because population decline should be a slow and orderly process.

In many developing countries couples desire three children or more. **Therefore, even with perfect contraception and no unwanted pregnancies, the population of those countries would continue growing unless desired family size is reduced**. If that is not done there can be no hope of achieving what is needed: a level of fertility substantially below the replacement level.

Family planning, the provision of contraceptives, is essential. Other vitally important measures include improving the status of women, and their education and job opportunities. But all such measures need to be supplemented by non-coercive incentives and disincentives to reduce desired family size by encouraging couples to have not more than two children. Examples of non-coercive incentives and disincentives would include tax and financial incentives, and preferences for employment and housing for couples with not more than two children. Family limitation, not just family planning, must become the order of the day. The two-child **maximum** family must become the norm (Grant, 1996).

The Global Economy versus Per Capita Income

We are faced with the following dilemma: On the one hand is the need to reduce the size of the global economy. On the other hand is the need to raise per capita income to an adequate level for most of the billions of people in the developing nations, and for tens of millions of poor people in the developed nations. There is also the need, of course, to maintain

an adequate income for those whose income is already satisfactory.

There is only one way that this conflict can possibly be resolved, and that is by reducing the number of people. There is no other way that per capita income for many can continue to increase while, at the same time, the global economy is being reduced to, and then maintained at, a size that would be sustainable.

The conventional wisdom seems to be that economic growth must continue if what really counts, per capita income, is to continue to grow. If persisted in, however, global, or aggregate economic growth will diminish per capita income. That is because at some point, if we do not halt it voluntarily, economic growth will be brought to a halt by environmental constraints (either from resource shortages, or because the absorptive capacity of our environment for pollution has been exceeded).

Thus, over the long term, aggregate economic growth and per capita income growth are not compatible, but are in direct conflict.

Economic Growth – A Two-Edged Sword

The industrial revolution, which has been responsible for our amazing economic growth over the last two centuries, has brought a better life and a higher standard of living to many of the world's people. Economic growth, in many ways, has been a blessing, but hardly an unqualified one.

At the same time it has created tremendous problems because of its unavoidable by-products: pollution and resource depletion. Among the terrible costs of economic growth have been rapid depletion of our fossil fuel deposits which took nature hundreds of millions of years to create, but which, if consumption continues at present rates, face imminent exhaustion.

Even more serious, because the pollution and waste products generated by human economic activity have overwhelmed the absorptive capacity of our ecosystem, continued economic activity at the present level, or at even higher levels, threatens to destroy the earth's natural systems, upon which all economic activity, and life itself, depend.

Cornucopians mistakenly believe that technology and human ingenuity can solve any problems associated with population and economic growth. They argue that both population growth and economic growth have historically gone hand in hand, and can continue to do so indefinitely. They point out that, in many countries, such indicators of human welfare as diet, life expectancy and per capita income have improved along with population growth.

But they fail to realize that the human economic activity that has made possible such improvements in welfare is not sustainable. Almost any size population at almost any standard of living can be maintained, but only for short periods of time. Their perception is akin to that of the man who jumped off a 20 story building and was convinced that all was for the best in the best of all possible worlds until he arrived at the bottom.

The fact is that there is no technological solution to the problem confronting us – how to create an economy that will be sustainable indefinitely, with an adequate standard of living for all. It is true that science and technology can ameliorate the impact of a given level of economic activity on our environment by discovering new ways to use energy and materials more efficiently, in order to reduce the throughput of energy and materials and the output of waste and pollution per unit of production. But such measures are no substitute for reducing our impact on the environment by a reduction in population to a sustainable level.

Exponential Growth and Doubling Time

An understanding of exponential growth and the concept of doubling time is essential to understanding that no material growth can long continue on a finite planet. Exponential growth can be described as the result of a constant annual growth rate applied to a constantly increasing base. Interest on a savings account is a good example.

One of the characteristics of exponential growth is that, at a given rate of growth, the time it would take anything (e.g. money, the economy, or population size, etc.) growing at that rate to double in size can be fairly accurately calculated by dividing the constant annual growth rate into 70. For example, money invested at an interest rate of 7% would double in 10 years. A population growing at a 2% annual rate would double in 35 years.

It is puzzling that those who advocate continued economic growth seem not to understand the basic concept of doubling time. For the United States and

other developed countries, economists consider that an annual economic growth rate in the range of two to four percent is normal and achievable. The doubling time for economic growth at the rate of three percent a year, for example, is roughly 23 years (70 divided by 3). It would take, therefore, slightly more than 100 years for an economy growing at that rate to have doubled five times and be (if the world's resources could possibly allow such growth) a staggering 32 times larger than it is today. Another five doublings would result in an economy over 1,000 times larger than today's.

The absurdity of the belief that economic growth can long continue is apparent. No resource, regardless of how large, can possibly withstand more than a very few doublings (Bartlett, 1978).

Pretending Won't Make It So

We must stop pretending that a global economy with a world population of 10-12 billion could possibly be sustainable. Our already overstressed ecosystem cannot provide, for the long term, an adequate standard of living for our present huge world population of six billion, much less for the even vaster numbers awaiting us unless we take action now.

Our nation's leaders, and world leaders, must face up to the reality that a global economy and world population that greatly exceed an optimum size are not sustainable, and will eventually result in an economic and ecological catastrophe.

Our present goal seems to be to provide an ever rising standard of living for ever increasing numbers, but that must be seen for what it is: an impossible dream. **The great lesson of the industrial revolution is that vast numbers of people are simply incompatible with an industrial society.**

Further population growth on the gigantic scale now projected is not inevitable. With the will, we could start now on the path toward a sustainable global economy by first reducing, then stabilizing world population in the range of 1.5 to 2 billion. The negative rate of population growth we need in order to do so depends on our achieving levels of fertility substantially below replacement level in all the countries in the world. Almost all the developed countries have already reached that level.

More than 90 percent of future world population growth is projected to occur in the developing countries. To achieve a below replacement level fertility in those countries, there must be put in place rigorous population programs geared to family limitation (no more than two children) rather than to family planning alone. Family planning must be supplemented by non-coercive incentives and disincentives to encourage the two-child limit per woman.

Mankind at the Crossroads

Earth is truly in the balance as the third millennium opens. The United States has the opportunity to lead the world by its example and its support for family limitation toward a smaller, ecologically sustainable population and economy in the 21st century. The task before us, because of its size and complexity, is an awesome one. But the alternative to our goal of a sustainable world economy is unthinkable — widespread poverty and misery in a dreary and depleted environment inhospitable to human life.

If we continue to ignore the constraints to growth imposed by a finite world, technological and industrial man may well turn out to be a strictly temporary phenomenon in the long history of life on this planet. We are living at a momentous time in history. We still have the power – if we can only develop the will – to halt and reverse population growth. **That power, if not exercised, may no longer exist even a few years from now.**

Mankind today stands at a crossroads. One road, that of further population growth, leads inevitably to starvation, poverty, social chaos and war. It leads to the certain destruction of all that we hold dear, including personal freedom and political liberty, peace and security, a decent standard of living, and a healthy environment.

The other road leads to population stabilization at a sustainable level after a transition period of population decrease. **That is the road humanity must start down now**. It leads to a world population in balance with its environment and resources, thus creating the condition that will allow the human race to live in peace and prosperity for as long as spaceship earth shall continue to exist.

Notes

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