NPG Forum

In Support of a Revolution...

by Lindsey Grant

In 1995, Dr. J. Kenneth Smail wrote an NPG Forum essay entitled "Confronting the 21st Century's Hidden Crisis: Reducing Human Numbers by 80%." The article was picked up by other journals, and an expanded version was published in the September 1997 issue of the journal ***Politics and the Life Sciences*** *under the title "Beyond Population Stabilization: The Case for Dramatically Reducing Global Human Numbers." Concurrently, the editors of the journal asked me to comment on the article. That commentary – which is in reality a presentation of concrete examples supporting Dr. Smail's thesis – is the basis for this Forum.*

Very few writers seem to recognize that growth cannot continue forever in a limited space, and that mathematical truism applies to the real world, today. Dr. Smail is one of those few who do. Moreover, he suggests that human numbers have already passed the long term capacity of the Earth to sustain us and that an optimum world population lies perhaps in the range of 2-3 billion. So short is memory that the proposal sounds revolutionary – almost blasphemous – to most ears. Humans' ability to accommodate to change is both our strength and our peril. People have learned to consider six billion "normal," and presumably they will try to adjust to 10 or 12 billion, desperate as their situation may be by that time. More public concern is being expressed at the prospect that Europe and Japan (two of the most crowded regions on Earth) may experience a population decline than that most other regions on Earth are drawing us into a nightmare born of population growth. Yet Dr. Smail's target is a population that was "normal" in 1950.

I agree with Dr. Smail and have no problem with his argument or with most of his assumptions. Rather than doing an exegesis on them, let me offer some brief examples of specific ways in which the interactions of demography and the environment are presently driving the human condition in precisely the wrong direction. They will, I believe, corroborate his thesis that a population turnaround is necessary.*

Divergence and Convergence

We live in a world riven by a deepening dichotomy. For most of the "third world," the issue is sheer numbers. The present population explosion resulted from a terrible failure of foresight. Starting particularly in the 1950s, the application of basic hygiene generated a sudden decline in mortality. In the subsequent decades, the revolution in agricultural productivity made it possible to feed those expanding populations – at a very high environmental price. A fundamental instability occurs when one side of a natural balance (mortality) is lowered without lowering the other side (fertility). The price of that failure, in much of the world, was the loss of a dream that was momentarily possible: the hope of creating a world in which there is enough for all.

The old industrial countries, on the other hand – and now some "newly industrializing countries" that are joining them – have benefitted from the technological explosion that started with the industrial revolution. In one vital respect, success fails. The distinguishing feature of modern human economic activity has been the accelerating rate at which we have altered the environment in the pursuit of economic production. This unintentional by-product must at some point limit economic activity, simply so we can preserve the ecosystems that support us. Although we do not have the knowledge to identify the precise point, it is clear that in some vital respects human activity is beyond a supportable level. Keynesian economics takes no account of such "externalities," and they go largely unrecognized.

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Those two human conditions, contradictory as they may appear, are synergistic in their effect on the planet.

The biosphere lies about us and seems to extend forever. That perspective is a result of our own eye level. We are part of it. Consider it from a more distant vantage point, and one sees it as hardly more than a molecular film on the Earth's surface. On land, it lies almost entirely within the tiny thickness stretching from the plant roots to the treetops. It is much thinner than that in the treeless areas covering most of the Earth's land surface. On the oceans, it is somewhat thicker but much more diffuse.

Into that very limited space, the industrial revolution and human proliferation have been pouring carbon, nitrates, phosphates and sulfur at a rate comparable to the natural input. The industrial emissions of lead into the atmosphere in 1990 were 12 times the natural releases. For copper, the ratio was nearly 6 to 1, for cadmium 5 to 1, for arsenic 1.6 to 1, and we have introduced literally millions of chemicals unknown in nature – with little or no understanding of the consequences.

We need a period of consolidation, not driven by rising demand, to learn more about the consequences of our own activity.

I will offer three brief case studies of the impact of demography on human well being.

Chemical Fertilizer and Food Production

My first example is the agricultural trap into which we have fallen in the effort to drive yields up to feed growing populations.

A Canadian professor named Vaclav Smil asks a fascinating question: What was the most important invention in the twentieth century? His unlikely answer: the Haber-Bosch process of synthesizing ammonia, and therefore nitrogen, introduced in 1913.

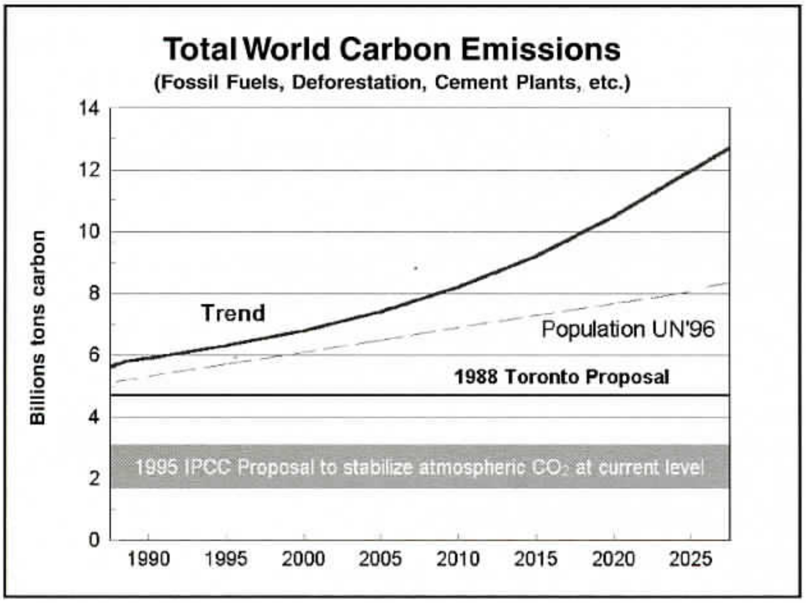
Nitrogen, Smil pointed out, is essential to chlorophyll, DNA (deoxyribonucleic acid), RNA (ribonucleic acid), proteins and enzymes – in short, to life itself. There are only three natural atmospheric processes for converting atmospheric nitrogen, which is locked up in N_2 molecules, into a form usable by plants and animals: falling meteors, ozonization and ionization by lightning. The only biotic process is the creation of ammonia by various bacteria, most notably by the rhizobium bacteria that live symbiotically on the roots of legumes (such as peas and beans).

Nitrogen and water are the two most important limiting factors in plant growth. Until the Haber-Bosch process, humankind could obtain nitrogen only by recycling it or green manuring with legumes.

Yields per hectare are the critical issue. By and large, the land that can be farmed is being farmed. Worldwide, arable acreage is headed downward. Food yields must more than match population growth just to maintain a constant level of nutrition.

That is where synthetic ammonia comes in. Its invention permitted agriculture to support an unprecedented population. By Smil's calculations, synthetic fertilizers now provide the nitrogen for about half the annual global crop harvest. Put more starkly: Were it not for synthetic fertilizer, the richest nations could probably get by with a change of diet, substituting cereals for meat, but perhaps one-third of the people in the more crowded and land-poor third world countries would starve. This dependence is absolute. If more nitrogen cannot sustain the growth of yields, our only choice is to constrain the demand for food – voluntarily or otherwise.

This brings us to a critical problem. We are in the era of the declining response curve. Adding progressively more fertilizer produces diminishing increases in food output. Eventually, it produces a zero increase. Corn yields in the United States are now flat. The only escape is to keep finding new technologies, and one of the great unanswered questions of our time is "can we keep it up?" An FAO official listed "the plateauing of yields of high-yield varieties" as the principal food supply problem right now, along with land degradation. The only dramatic new technology in sight is genetic engineering. At best, its contribution is a long way off; at worst, it may be very limited. Population growth is with us now, and to argue the hope of salvation by technology is an imprudent policy indeed.



The absolute limit to fertilizer use is reached, of course, well before the response reaches zero. When the added output doesn't pay for the fertilizer, food production hits a wall.

The developed world is very close to that wall. U.S. fertilizer use per hectare is only one-fourth of that in Japan, because Japan maintains rice prices five times the world level. Our average cereal yields are 85% of those in Japan, even though we grow cereals in generally drier regions. The Japanese didn't get much for that extra fertilizer. Both we and they know that. Fertilizer use in both countries has been declining for years.

The reliance on chemical fertilizers has even more serious consequences.

It tends to lower quality of the soil.

The pursuit of high yields leads to reliance on a very few high-yield crop strains and to continuous planting rather than crop rotation. Limiting the number of plant varieties and continuous cropping are both invitations to the proliferation of crop pests. This leads to the intensive use of pesticides. The fertilizer and pesticides in turn cause water pollution and threaten fisheries and other species. We still cannot measure the impacts on forest and water resources of that activity.

Pests mutate and become resistant to known pesticides. The very process of fighting insects and other pests has a frightening side effect: it promotes the evolution of resistant strains and species. The mechanism is fairly straightforward: create conditions that are ideal in all respects except one – for example, a field full of corn, replanted annually, as seen by a corn borer – and there is a tremendous reward to the organism that learns to handle that one negative factor, the pesticide. That is what leads to successful mutations. Successful, that is, from the standpoint of the pest. The more intensive the agriculture, the more likely the consequence. If farmers have no effective defense, a blight can lead to the loss of an important fraction of food supplies. The United States narrowly averted such a corn blight in 1980. The fungus that led to the Irish potato famine is endemic in the United States. Aggressive and resistant forms appeared in Europe in the 1980s and the United States in 1990. Either the corn or potato blight, or something else, could surface in a more virulent form.

Losses to pests have risen despite massive increases in pesticide use in the past two generations. U.S. crop losses from insects, by one estimate, doubled between 1945 and 1989 to 13% despite a tenfold increase in the use of insecticides. Losses from all pests, including plant pathogens and weeds, are estimated at 37% of total potential food and fiber crops. The pesticides, aside from promoting resistant pests, destroy the natural predators that could control pest outbreaks, and they kill bees that are important to crop pollination.

Despite the penalties, farmers are dependent on pesticides and herbicides. The farmers are on a treadmill because they would lose part or all of their crops if they stopped spraying, given the decline of natural predators.

Some 20 to 40 million tons of nitrogen escape annually from the world's croplands into the atmosphere as nitrous oxide (N_2O). Commercial fertilizers account for perhaps 40% of that release, depleting stratospheric ozone and contributing to the greenhouse effect. This consequence intensifies as intensive agriculture spreads, and it gets progressively worse because a flattening response curve demands more and more fertilizer, until one reaches the wall.

In sum, population imbalance requires a pursuit of high yields that in turn demands reliance upon "solutions" of diminishing effectiveness and rising cost, which in turn generate a ripple of disturbances.

This is a picture of agriculture out of balance. It can be put in balance only if potential productivity is enough higher than demand so that farmers will move back to more benign but less intensive agricultural practices. And that shift gets harder and harder as population grows.

That is the synthetic fertilizer trap. With six billion people on Earth, we cannot go back to techniques that supported two billion.

Climate Change

My second example involves climate alteration, primarily the result of carbon releases from fossil fuel use and the destruction of forests by rising demand for logs and by rising populations seeking land to cultivate.

Amid a welter of scientific controversy, the Intergovernmental Panel on Climate Change represents the nearest thing to a world scientific consensus on the human effect on climate. The IPCC in December 1995 produced its "Second Assessment" of climate change and its probable results.

Their key finding was that "The balance of evidence... suggests a discernible human influence on climate." Global mean surface temperature and global sea level have risen in the past century. If the trend is not reversed, the scientists expect that temperature will rise 1° to 3.5°C by 2100 – faster than any warming trend in the past 10,000 years. They warn that climate is a complex and nonlinear system and that "surprises" may happen, such as "rapid circulation changes in the North Atlantic," with profound consequences for European and world weather.

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They project a rise of 15 to 95 centimeters (cm) in average sea level by 2100, with a best guess of 50 cm (20 inches).

Even if the immediate stabilization of greenhouse gases were achieved, the present level of climate forcing would continue, and "global mean surface temperature would continue to rise for some centuries and sea level for many centuries." Scientific caution has limited their projection, but hidden in that sentence is the possibility that, uncontrolled, human activities could take us back to the climate of the Cretaceous, when shallow seas covered much of what is now densely populated land. With six or ten billion people, or more, there would be nowhere on Earth for those displaced to go.

What would it take to stop the engine? It would require *"an immediate 50-70% reduction in CO_2 emissions and further reductions later on to stabilize atmospheric carbon dioxide at current levels."* (my emphasis) This would be needed – not to end the human impact on the climate – but simply to keep the trends from accelerating.

Let us see how humanity is succeeding in that awesome task. The graph on page three may help.

Far from approaching that level, or even the more modest goal of the Toronto convention, real world emissions are rising rather than falling. I have drawn the UN median population projection (in billions) into the graph. Carbon emissions are rising even faster than population, because of forest cutting and accelerated industrial activity.

This graph brings us face to face with the problem most people would like to ignore: What level of human population can the Earth sustainably support? Climate may be a limiting factor if food production is not. The data are not available to draw a tight logical conclusion, but I would ask the reader to consider how much better our prospect would be if the "Population" line on the graph were a flat line somewhere between two and three billion. It would put us within sight of the goal by the IPCC scientists. A smaller population would not need to cut forests at the present rate, and the forests could perhaps even become a sink for atmospheric carbon rather than a source. Coupled with reasonable energy efficiencies, we could be on the way to solving the problem of human forcing of the climate.

Biological Diversity

My third example may be the nearest of all to a doomsday scenario. Human activities are sequestering something like 40 percent of terrestrial productivity for human use, and we are changing the atmosphere and the climate everywhere. The combination is causing the loss of species at a rate we cannot measure but which certainly is unparalleled since the Cretaceous extinctions.

Biological diversity is probably associated in the public mind with a fondness for pandas or elephants or our relatives, the great apes. In Africa, we are watching a dramatic change as human populations displace other large mammals. But biodiversity is much more than that. We are just beginning to recognize our interdependence with microorganisms, but we still know very little about the effects we are having upon them. In 1983 the President's Acid Rain Review Committee pointed out that soil microorganisms are particularly susceptible to a change in acidity and warned that:

> *"it is just this bottom part of the biological cycle that is responsible for the recycling of nitrogen and carbon in the food chain. The proper functioning of the denitrifying microbes is a fundamental requirement upon which the entire biosphere depends. The evidence that increased acidity is perturbing populations of microorganisms is scanty, but the prospect of such an occurrence is grave."*

The early successes of the Clean Air Act Amendments momentarily alleviated the acid precipitation problem in the United States, but it and the related issues of ozone and nitrogen leaching are driven by the levels of our economic activity, and our knowledge of soil bacteria and their limits of tolerance has not much improved. Prudence suggests that we must reduce those harmful emissions – by better control of fossil fuel burning in the short term and its reduction or elimination as soon as possible – and by limiting the demand that makes the heavy use of chemicals and fossil fuel necessary.

We must control air pollution and climate change, and we must reserve some space for other creatures. How much? There is no certain answer, but some substantial fraction of the Earth must be left. This can be achieved only with a smaller population, not with the sort of growth that rapidly displaces other species.

Optimum Population

Discussions of the Earth's carrying capacity are usually founded on an unstated premise: that the objective is to see how many people can be crammed on a finite Earth. That is the wrong question. For one thing, it is usually based on a one-time calculation. Slowly, we are learning that a wiser question is "would that level be sustainable?"

Dr. Smail has pointed out that there is yet another and better question: "how many people would constitute a desirable level?" Consumption is not an environmental sin, though one might infer from much current writing that it is. For poor individuals and nations, it is a highly desirable objective. The moral issue arises from an impossible combination: large and rising populations, and the hope of achieving a decent standard of living for all. A smaller population could live better, and still preserve the environment.

Conservation and technology can help to mitigate environmental problems without a loss in real living standards, but they are no substitute for a wiser demographic policy. Dr. Smail cites the possibility of reducing energy and resource wastage by half or two-thirds through such measures. An optimistic estimate. Moreover, energy is not a legitimate surrogate for all environmentally damaging activities. I have pointed out that large and rising populations require rising food yields, which in turn require massive and rising chemical fertilizer inputs. This is not "wastage" in the usual sense, but most of it could be avoided with a population half the present size, requiring half the yields. That could be achieved with benign farming using organic inputs. The decline in chemical fertilizer use would be more than proportional, and world agriculture would escape the nitrogen trap I described.

For the poor, a better living is a dream realizable only with a smaller population; for the prosperous, the preservation of decent living standards depends on the same change. Two or three billion is not a bad target. We must not bog down in scholastic debate as to the exact number. The issue is the direction. And that must be down, and as soon as possible.

There is not much time for a revolutionary change in human behavior. Barring a catastrophe, momentum will carry human population upwards to 9.4 billion in the next half century even if average fertility in the poorest countries (the UN's 48 "least developed") should plunge by 60 percent. That would be a remarkable achievement indeed; it has declined only 15 percent since the 1950s (UN 1996 data and medium projection). To turn growth around, humanely, and bring population down to two billion would take centuries – unless we suffer the consequences of our present behavior, and population growth is reversed through the brutal mechanism of rising mortality.

Note

* *This paper is based upon my book **Juggernaut: Growth on a Finite Planet** (Santa Ana: Seven Locks Press, 1996). Except as noted, data are taken from that source.*

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