2007

The Perfect Storm: Catastrophic Collapse in the 21st Century

Glen Kuecker
DePauw University, gkuecker@depauw.edu

Recommended Citation

This is the post-print of: Kuecker, Glen, "The Perfect Storm: Catastrophic Collapse is the 21st Century." *The International Journal of Environmental, Cultural, Economic & Social Sustainability.*Vol. 3, Issue 5. (2007): pp. 1-10. Copyright of the article is held by the publisher. Permission must be obtained to reproduce this article. The published article may be found here: http://ijs.cgpublisher.com/product/pub.41/prod.350

Checking your Typeset Proof

Multi-Authored Papers

In the case of multi-authored papers, authors are advised to collaborate when checking the typeset proof. One author should be nominated to either accept or submit corrections on behalf of all of the authors of the paper.
We can only accept one set of revisions, or one acceptance of the typeset proof, from the nominated author. Once an author approves the typeset proof further revisions may not be requested.

Replying to us

After you review the typeset proof, you need to click on the 'Author Verify Typeset Proof' button (available at the link you downloaded the typeset proof from). You will then need to select the appropriate option to proceed.

Option 1: Accept Typeset Proof
To be selected when your paper is ready for publication

- Please thoroughly check the typeset proof before accepting it. You will not have further opportunities to make additional changes after the typeset proof has been accepted.
- Once you have accepted the typeset proof of your paper it will be ready to be published. You will be notified when your paper has been published and given instructions on how to access the published version.

Option 2: Request Resubmission of Typeset Proof
To be selected when your paper requires corrections

- Please see section on 'Documenting your Corrections'.
- The typesetter will receive notification of your requested corrections. Once the corrections have been completed you will be notified of the availability of a revised typeset proof for your approval.

Bibliographical Details

Please note that full bibliographical details (issue and page numbers) will not be available until final publication of your paper. Once your paper has been published you will be able to obtain these details. We will notify you as soon as your paper is published.

Checklist for Reviewing the Typeset Proof

We recommend that you print the typeset proof and proofread it slowly and with great care. Request that a colleague also proofread your paper as they may notice errors that you may miss due to your familiarity with the content.

Remember to check your typeset proof for:

- Completeness: inclusion of all text, figures, illustrations and tables
- Correct title and subtitle
- Correct authorship and order of authors
- Current affiliation details
- Heading levels
- Position and size of illustrations and figures
- Matching of captions to illustrations and figures
- Position of tables
- Presentation of quotes
- Presentation of equations
- Footnotes and footnote numbering
- Inclusion of acknowledgements
- References and reference style
- Typesetting or conversion errors

Please check the Journal Standard Style prior to requesting changes to style as we adhere to standard presentation requirements for all papers to ensure consistency throughout the Journal.

It is important that all of your corrections (and those of your co-authors if applicable) are submitted to us in one communication.

Please note that careful proofreading is solely your responsibility.

Journal Standard Style

Order of the Paper:

1. Cover page
2. Copyright/imprint page
3. Paper: title/subtitle; author names with affiliation; abstract; keywords; body of paper; acknowledgement (if applicable); reference list; appendix (if any); about the author section
4. Journal colophon

Journal Standard Style:

- Paper title/subtitle and all headings appear in Title Case whereby only definite and indefinite articles (e.g. 'the' and 'a'), conjunctions (e.g. 'and'), and prepositions (e.g. 'in', 'of' etc.) appear in lower case.
- No italics in titles and subtitles.
- Affiliation of the author will include only the name of the author, university or organization name and country. Honorifics are not included.
- Abstract will appear in italics as a single paragraph.
- No italics included in the keyword list.
- No footnotes attached to title/subtitle, authors or the abstract.
- The first paragraph of the paper will appear in floating style - first three words appear in capital case and bold.
- Footnotes within tables have separate numbering to that of the footnotes within the paper.
- Hyphenation cannot be altered.
- No underline will be included.
- Figure captions are centred below the figure. The figure number and caption appear on the same line.
- Table titles appear above the table, left justified, in bold. The table number and table title appear on the same line.
- Flow of columns: If a figure or table appears in the middle of the page then the flow of the text will be from top left column to top right column, followed by table or figure. The remaining text will begin in the left column under the figure/table and will continue in the bottom right column.
- About the Author section: The honorific will reflect in this section. Contact details such as email addresses will not be included.

Documenting your Corrections

Changes to the Abstract

If you wish to make changes to the abstract of your paper please provide the revised abstract either as a Word document (if there are also changes to the text), or by entering it in the text box provided when you select Option 2.

Additional Authors

If you need to add a co-author we require the following information for each additional author to be added:

1. Name of the co-author
2. Affiliation details
3. Email address of the co-author (Mandatory)
4. Short Biography (limit of 30 words)
5. Long Biography (limit of 200 words one paragraph only)

Corrections to Text

If you have changes to the text please complete these in the Word version of your paper available at the link where you downloaded this PDF (or an existing word version). You can then upload the revised document for typesetting by selecting Option 2.

Corrections to Style:

You will need to clearly indicate all corrections in the following manner:

1. Page Number - paragraph number - line number - correction to be made
eg:
1. Page 4 - last paragraph, line 4, please put a comma after Tom in the sentence Mary, Tom, Jane and her friends...

The page number is the actual page of the PDF. As the paper has not been paginated yet, no numbers appear on the pages.

Submitting Corrections

Click the 'Author Verify Typeset Proof' button (available at the link you downloaded the typeset proof from) and select Option 2.

Option 2: Request Resubmission of Typeset Proof

- Please upload the corrected Word document, or add your instructions for corrections in the text box provided
- Note that you can only upload one document, and this document must contain all of the corrections (and those of your co-authors if applicable).

The typesetter will receive notification of your requested corrections. Once the corrections have been completed you will be notified of the availability of a revised typeset proof for your approval.

The International JOURNAL of ENVIRONMENTAL, CULTURAL, ECONOMIC & SOCIAL SUSTAINABILITY

Volume 3

The Perfect Storm: Catastrophic Collapse in the 21st Century

Glen Kuecker

COMMON GROUND

www.sustainability-journal.com

THE INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY
http://www.Sustainability-Journal.com

First published in 2007 in Melbourne, Australia by Common Ground Publishing Pty Ltd
www.CommonGroundPublishing.com.

ISSN: 1832-2077
Publisher Site: http://www.Sustainability-Journal.com

The THE INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY is a peer refereed journal. Full papers submitted for publication are refereed by Associate Editors through anonymous referee processes.

Typeset in Common Ground Markup Language using CGCreator multichannel typesetting system
http://www.CommonGroundSoftware.com.

The Perfect Storm: Catastrophic Collapse in the 21st Century

Glen Kuecker, DePauw University, Indiana, USA

Abstract: This paper utilizes complex systems theory to argue that we are currently living in catastrophic collapse of the global system. It focuses on topics like climate chance, ecological destruction, pandemics, fuel shortages, warfate, and global hunger to illustrate the interconnections between multiple points of failure within the global system. The argument maintains that sustainability perspectives miss the fundamental reality of the global crisis.

Keywords: Sustainablity, Complex Systems, Global Warming, Climate Change, Pandemics

FORMER VICE PRESIDENT Al Gore's documentary *Inconvenient Truth* has awakened people to the twin problems of global warming and climate change. An April 2007 poll shows that even 60 percent of Republicans now think these issues are serious (*Time*, 28 May 2007). As follow-up to the documentary, a group known as the "Focus the Nation" has organized discussions about Gore's dire warnings and possible solutions. Planners envision an energized civil society participating in grassroots forums at their churches, grade schools, offices, and universities. In April 2007 they held a national conference in Las Vegas, where people convened to share results of their meetings and plan the next step in saving the planet. Gore has stimulated a remarkable mobilization, one that has the potential to reach millions of people in consideration of what many think to be the most important issue of the 21st Century (http://www.focusthenation.org/). It may influence the United States government to take more aggressive measures in combating global warming, especially because other grassroots campaigns, like Bill McKibben's "Step It UP" (stepitup07.org and McKibben, 2007b) are underway. If we depart from hydrocarbon civilization, the mobilization will have resulted in a revolutionary shift in economy and society comparable to the industrial revolution. The paradigm shift called for by Gore's followers would be one of the greatest in history, similar to the abolition movement.

The current global warming movement, however, has several critical flaws, which may cripple its mission. Foremost, it is a single-issue approach, one that neglects substantive consideration of the interconnections between climate change and several other major crises. Failure to see climate change as part of a larger systemic crisis results in misguided public policy, and a naive confidence in the ease of paradigm shift. The core of the flaw is the emphasis on sustainability, which falsely sees collapse not as a current reality but a future event. To avoid collapse the sustainability view takes a reformist position; with just enough timely tinkering the system can go on forever without any radical change. To use the coal miner's canary metaphor, this view sees the canary as alive, although gasping for air and needing better circumstances. Instead, we need to understand that the canary is dead, and we need to evacuate the coal mine. The time for making sustainability happen has long passed, and its belated pursuit will prevent us from addressing the present reality of catastrophic collapse.

Hurricane Katrina may help people in the United States to see catastrophic events as immediate and long lasting challenges to humanity. Katrina woke people up to how inadequately prepared local, state, and federal governments are in the face of large-scale catastrophe, how sophisticated public policy crumbles in application, and how scarce public resources drained by colonial projects undermine vital infrastructure required for sustaining modernity's complex systems. Hurricane Katrina also teaches how pre-existing race and class inequalities shape catastrophic outcomes by defining who is evacuated, rescued, and attended. It also re-mapped the public's geography of catastrophe by bringing an event associated with the global South to the global North (Walter, 2006a). Some wisely question the state of preparation for other inevitable catastrophes (Brinkley, 2006; Copper and Block, 2006; Horne, 2006; and Dyson, 2005). Despite such advances there exists a delusional quality to our thinking, as if we are unwilling to stare directly at the obvious reality that our modern life is structurally flawed on multiple fronts that have converged in starting the preliminary phases of catastrophic systemic collapse.

Even among those who approach global crises from a system perspective, there is an overwhelming propensity to construct a master narrative of optimism. It maintains that while the system is in deep

crisis we still have the opportunity to escape if only we act now. David Korten, clearly illustrates his conviction that the global system is not on a sustainable course, the "Siren Songs" have been played, and we are not listening to the warning because of delusion, ignorance and/or benign neglect (Korten, 1999 and 2001). Jared Diamond states:

> The risk of such collapses today is now a matter of increasing concern…. Many people fear that ecocide has now come to overshadow nuclear war and emerging diseases as a threat to global civilization…. Most of these threats…. it is claimed, will become globally critical within the next few decades: either we solve the problems by then, or the problems will undermine not just Somalia but also First World societies. Much more likely than a doomsday scenario involving human extinction or an apocalyptic collapse of industrial civilization would be 'just' a future of significantly lower living standards, chronically higher risks, and the undermining of what we now consider some of our key values (2005: 7).

He adds, "for the first time in history, we face the risk of a global decline" (2005: 23). The authors of *Limits to Growth* clearly argue that the world is in "overshoot," and we are set on an unsustainable course. Their multiple models demonstrate a short time period, within 50 years, before systemic collapse will replace overshoot. They state:

> The global challenge can simply be stated: To reach sustainability, humanity must increase the consumption levels of the world's poor, while at the same time reducing humanity's total ecological footprint. There must be technological advance, and personal change, and longer planning horizons. There must be greater respect, caring, and sharing across political boundaries. This will take decades to achieve even under the best circumstances. No modern political party had garnered broad support for such a program, certainly not among the rich and powerful, who could make room for growth among the poor by reducing their own footprints. Meanwhile, the global footprint gets larger day by day" (Meadows, Randers, Meadows, 2004: XV).

The 2006 edition of *State of the World* explains, "Unless we find a couple of spare planets in the next few decades…. it is clear that the current western development model is not sustainable. We therefore face a choice: rethink almost everything, or risk a downward spiral of political competition and economic collapse" (Flavin, 2006: xxi-xxii). Thomas Homer-Dixon also clearly demonstrates the likeliness of systemic collapse, but his *Ingenuity Gap* maintains an optimistic line of analysis (2000). In a subsequent book Homer-Dixon finds collapse to be almost certain, so much so he invites us to prepare for it by considering how catastrophe allows for the total regeneration of civilization (2006). These master narratives each have a firm conviction that the coal miner's canary is very much alive, and inhibit us from considering the canary's actual death.

Clifford Geertz suggests the reasons for why we deny the canary's death. He states:

> The main problem, over and above their mind-bending dimensions, is that these various sorts of mega catastrophes seem to most people either so far off, so unlikely, or so thoroughly beyond what they have even vicariously experienced—psychologically off-scale, conceptually out-of-sight – as to be beyond the range of rational estimation or practical response. We are both emotionally disinclined and intellectually ill equipped to think systematically about extreme events. Absorbed as we are in the dailiness of ordinary life, and enfolded by its brevity, the calculation of remote possibilities and the comparison of transcendent cataclysms look pointless; comic, even (2005: 5).

Denial invites us to frame catastrophes as unique, disconnected, and particular events. We see unexpected tragedy as the only common ground between September 11th, the Tsunami, or Hurricane Katrina. Wrongly framed, our picture of what catastrophes are results in bad public policy that make disasters so much worse when they happen. The consequences are immense, as each catastrophic event carries a bigger punch, and our ability to survive is further compromised (Diamond, 2005; Geertz, 2005; Homer-Dixon, 2006: 29-30).

To correct this problem we need to see catastrophic events as part of a larger process, as multiple points of structural crisis converging to form the "Perfect Storm" of the global system's catastrophic collapse. We need to understand catastrophic collapse is currently in process, and it is not something looming in the distant future. We need to understand that avoiding the collapse by altering course is not possible, because the time for changing course has long passed. Catastrophic collapse means that framing current reality with analysis defined by sustainability misunderstands reality. Sustainability analysis remains within an old paradigm defined by a conviction that applied reason can solve the problems that may cause collapse. It is premised upon the Enlightenment's project of perfecting the human condition. The catastrophic collapse paradigm takes a post-Enlightenment position. In collapse the perfectibility

of the human condition yields to the basics of survival. Of course, surviving collapse will require implementing sustainability and wise application of the Enlightenment's paradigm of science and technology.

To appreciate this argument an explanation of complex systems is needed. Systems theory, while complex in application, has basic propositions. A system is constituted from multiple sub-systems, which in turn are the product of many interacting parts. Systems, especially as they evolve and become more complex in their structure and functioning, have three paths they can follow. They can reproduce, becoming ever more complex with each successive reproduction. Conversely, their interactions can set-off a catastrophic structural flaw that causes the interacting parts and sub-systems to destroy the system. In this case, the system stops functioning and enters a state of collapse. Between these two paths, rests the third possibility, oscillation. It occurs when systems wobble between the states of reproduction and collapse. It is an unstable state, sometimes called the "edge of chaos," in which a system can have periods of reproduction before yielding to periods of crisis (Clark, 2002; Perrow, 1984; Waldrop, 1992; and Homer-Dixon, 2000 and 2006). Meadows, Randers, and Meadows argue we are currently experiencing either oscillation or collapse because the system is in a state of overshoot, in which it has surpassed capacity for reproduction (2004).

Complex systems, especially those that have humans as key components, have remarkable survival mechanisms focused around the capacity to adapt to the unpredictable ways a system can evolve. An adaptive system finds solutions to potentially catastrophic interactions within the system. These solutions are technological fixes, and they are a driving force in systemic reproduction. Such adaptation, however, has important limitations. Often solutions only treat the symptom of the original problem, making the evolving system inherently unstable. The system eventually becomes so complex that it is not possible to predict possible outcomes of systemic interactions (Perrow, 1984). Unpredictability can throw a healthy system into oscillation, and an oscillating system into collapse. Likewise, and more dangerous, adaptation produces new and more complicated interactions in the system –what Homer-Dixon calls "unknown unknowns." They inevitably produce a catastrophic interaction for which innovative technology cannot fix (2000: 171-187).

The current global system -- the totality of systems, subsystems, and interacting parts – is producing a phenomenal level of "unknown unknowns." It is built upon centuries of technological innovations that create stopgap, band-aide solutions to underlying structural problems. We often are unable to anticipate the next systemic crisis, while we continue to compound the problem by adding temporary and misguided solutions. Our ignorance about complexity and unwillingness to take what we do know seriously means catastrophic events increasingly define the human condition. We continue to select public policies that are disastrous in their consequences, and we frequently mask them with professional, authoritative, or expert sounding language. The implications for wrong thinking are immense.

We confront multiple points of structural crisis within the global system. Even in isolation, anyone of these points could trigger a tipping point in the system, pushing it away from oscillation and into collapse. Each is capable of driving collapse deeper and faster, overwhelming our capacity to cope. A short-list of the ongoing structural crises includes: energy, environment, climate, disease, population, economics, and conflict. As the current global system is tightly coupled with a historically unprecedented degree of intensity, we need to recognize that each of the points of crisis is related to the others (Homer-Dixon, 2000: 112). Tight coupling can generate positive feedback loops within the system, causing a convergence of structural crises resulting in the "perfect Storm." Our current historical moment is defined by the initial phases of the storm.

With the price of gasoline floating at $3 a gallon, people in the United States are slowly waking-up from their SUV slumber to discover oil is not a renewable resource. They are also learning that the historical moment when oil is no longer available is rapidly approaching. In fact, most oil companies, economists, and academics agree that peak oil production is within the next twenty years, possibly ten. When Hurricanes Katrina and Rita disrupted the flow of petroleum into and out of the southern refinery sector, US citizens became keenly aware of our dependence on petroleum as well as the extreme vulnerability of the petroleum infrastructure, the system of production and delivery needed for our energy system to survive. As Daniel Yergin explains, a structural crisis in any part of the infrastructure can cause significant ripples or waves through the entire system – what is called a positive feedback loop--potentially causing regional, national, or global economic crisis (Yergin, 1991). As our pocket books suffer, awareness increases. But, this awareness is profoundly misguided about the problem.

As people pay more at the gas pump, they are seldom aware that peak oil production has profound consequences for the meaning of life on earth. Our civilization, as Yergin illustrates, is defined by hydrocarbons (1991: 541-560). They are omnipresent. Petroleum is not only essential for powering transportation systems, but also provides petrochemicals needed for synthetics in manufacturing, those plastics

that are in just about everything we consume (Kunstler, 2005: 23). The end of oil means we need to substitute petroleum with something new if we are to sustain the current levels and forms of production (Roberts, 2005: 1-17). Furthermore, Hydrocarbons are the key component in manufacturing the fertilizers that drove the Green Revolution's 250 percent increase in grain production and sustains the current system of intensive agriculture that nearly seven billion people depend upon (Kunstler, 2005: 159-160). While we already experience the preliminary phases of collapse within the fuel sector, peak oil production means we will soon have structural crisis in industrial production and food sectors of the global system.

Transitioning from petroleum to an alternative energy, food, and production source is an extreme challenge. We know that future oil consumption, especially with the needs of huge consumers like China and India, will continue to rapidly increase. Current demand is nearly 2 million barrels per day, and has an annual rate of increase at 2.25 percent (McKibben, 2004: 34). Global energy consumption will rise by 71 percent between 2003 and 2030 (Runge and Senauer, 2007: 44). This increased demand is hitting concurrently with the era of peak production, consequently decline in available oil will be rapid not gradual. Rapid depletion will cause major shocks within the system and make gradual and smooth transition exceptionally difficult to accomplish, especially on a coordinated and cooperative global level. Second, we know that finding alternatives to hydrocarbons is an exceptionally difficult if not impossible proposition.

Those seeking hydrocarbon substitutes focus mainly on energy. There is little discussion about how to supplant petrochemicals that underpin food and manufacturing systems. But even in the area of energy, the prospects are not good. Jeremy Rifkin illustrates that fuel substitutes range from solar, wind, hydro, and nuclear power, but they are not practical replacements. Many have invested great faith in the natural gas "bridge" to carry us over to hydrogen. Our future depends on making that bridge function while transitioning to a new fuel source. If we make it, hydrogen is a safe, renewable, clean, and long-term solution. But, getting to hydrogen is a dubious proposition, because the technology needed is closer to science fiction than application, costs are immense, and public policy is decades late in pushing the change. Oil interests also prevent rapid change, as they are committed to the dead energy system until the market tips in favor of hydrogen. The market's lag time is too long, and, most likely, we have passed the point of seamless transition to hydrogen. With a $600 billion price tag for its infrastructure just in the United States, the costs of a global hydrogen transition may be prohibitive (Rifkin, 2003).

Many people think biofuel provides a good hydrocarbon substitute. There are, however, several limitations with biofuel. First, producing biofuel still consumes high levels of energy, which often comes from coal or natural gas. Second, biofuel requires converting large tracts of land for sugar, soybeans, or corn. In many places, tropical forests are being cleared for biofuel production. With continued consumption of hydrocarbons and forest depletion, biofuel actually has the potential to increase green house gases (Moberg, 2007: 24-26 and Farrell 2006: 506-508). Third, biofuel deepens food insecurity by putting people and cars in direct competition for fuel (Azar, 2005). For example, "filling the 25-gallon tank of an SUV with pure ethanol requires 450 pounds of corn—which contains enough calories to feed one person for a year." Increasing ethanol production in the United States thus has consequences in countries like Mexico. Ethanol production has driven the price of corn from $2 per bushel to $4.35. This jump resulted in a doubling of Mexico's corn tortilla prices during the last months of 2006, which caused a subsistence crisis for nearly 50 million Mexicans living in poverty. Runge and Senauer warn, "resorting to biofuels is likely to exacerbate world hunger." They state, "the number of food-insecure people in the world [may] rise by over 16 million for every percentage increase in the real prices of staple foods. That means that 1.2 billion people could be chronically hungry by 2025" (2007). Biofuel illustrates how the promise of a quick and cheap fix to the energy problem, one that will allow the current system to continue without dramatic change, causes positive feedback loops within the larger system, resulting in grave, unintended consequences. The quick fix is part of the fallacy of the sustainability approach, because it glosses over the problems that emerge when radical change is avoided by shallow thinking.

If we navigate the transportation, production, and food crises, we still have to contend with climatic consequences of hydrocarbon civilization. Climate is perhaps the most complex of complex systems. A multitude of inputs feed the system and cause the "butterfly effect" of positive feed back loops resulting in potentially catastrophic climate change. Climate change illustrates how complex systems produce "unknown unknowns." While we do in fact know global warming is happening, its certain consequences are less known. The 2007 round of reports from the Intergovernmental Panel on Climate Change (IPCC) makes it blatantly clear that there will be negative consequences that require immediate and deep action to mitigate (McKibben, 2007a and IPCC, 2007). Only the most ignorant of fools rejects the

reality that the Gulf of Mexico's water temperature increased because of global warming. Kerry Emanuel's research shows that the power and duration of catastrophic storms is directly related to such temperature increases (2005). The IPCC supports this scenario by predicting more frequent and severe storms (2007). Melting of the polar ice caps also influences water temperature. Such change can alter the flow and temperature of the Gulf Stream, the engine that drives weather from North America to Europe. Such change may trigger droughts where predictable rains are known, and change the geography of climate that influences global economic systems. Climate change might do what Ché never could by flipping Eduardo Galeano's "upside down world" right side up (Galeano, 2000).

It is possible that the current increase in catastrophic weather events can tip toward conditions unfavorable to life on earth. We simply do not know. The Pentagon is concerned enough about climate change that it has ordered studies of worse case scenarios and how they impact national security. One study describes how climate change causes the breakdown of state systems resulting in civil wars, social upheaval, and mass migration. This scenario is beyond the capacity of the United States to manage (Schwartz and Randall, 2003). The United Kingdom's Ministry of Defence is likewise concerned, listing climate change as one of three global security threats (Development, Concepts, and Doctrine Centre, 2007). We only need visit post-Katrina New Orleans, a comparatively tiny example of response failure, to appreciate this concern (Brinkley, 2006 and Horne, 2006).

Climate change directly interacts with the global ecological system, one that is under immense stress even without climate change. As with climate change, the impact of altering ecological systems is very hard to predict. There are some basic guidelines, however. We know that life depends upon diversity for evolution (Berry, 1988: 45; Wilson, 1992). Extinction rates are far greater than at any point in human history, which means we are pulling key pieces from nature's design for a healthy complex adaptive system. (Meadows, Randers, Meadows, 2004: 85-86). Edward O. Wilson estimates 27,000 species are lost per year, and by 2022 an amazing 22 percent of all species will be extinct if we do not change course (1992). The Living Planet Index, which tracks population trends for over 1,100 species, finds that biodiversity has declined by 40 percent between 1970 and 2000 (Assadourian, 2006: 92). Each forest cutdown, each mega-damn constructed, each car that pollutes adds to the destruction of diversity. The earth has 24 major ecosystem "services" that sustain life. Scientists estimate 15 of them are degraded or have already tipped past sustainable limits. This destruction is a defining feature of catastrophic collapse, and it generates the positive feed back loops that prevent soft landings and post-collapse survival. (Millennium Ecosystem Assessment, 2005).

Similar to knowledge about climate change, we are starting to understand how adaptive responses to problems in one part of the global system can cause unanticipated, negative reactions in other parts of the system (Homer-Dixon 2000). The World Bank, for example, promotes shrimp farming throughout Latin America's Pacific coast in order to diversify economies. The farms, however, destroy coastal ecologies that ripple through interior ecological systems (Public Citizen, 2005 and Chafe, 2006: 100-101). Such destruction makes poverty worse, and can stimulate forces like migration and urbanization, causing problems in other parts of the system (Rich, 1994). Resource extraction, especially to meet high consumer demand in the first world, harms important ecological regions such as the Amazon and Indonesian forests. The "sinks" necessary for ecological systems to reproduce are increasingly clogged if not eliminated (Meadows, Randers, and Meadows, 2004: 51-127).

Some parts of ecology's complex system are deadly. An important one is disease. We already see the reality of catastrophe with the AIDS epidemic in Africa. Our inability to stop positive feed back loops that reproduce the epidemic is a grave cause of concern for how we respond to the next great pandemic, which many think will be the avian flu, a lethal strain known as H5N1. While a catastrophic outbreak has not yet happened, public health officials are in agreement that the question is not if it will happen but when (Osterholm, 2005 and Greger, 2006). This warning means that all the systemic factors for a major pandemic are now in place, with exception of the virus's ability to spread from human to human, which could happen at any unpredictable point in the future. H5N1 may kill more people than the great influenza Pandemic of 1918-1919, when upwards of 40 million people died globally. Illustrating the centrality of complex systems for understanding pandemics, H5N1 is geographically located in Asia, and is spreading there because of the region's dramatic economic boom, which has caused mass movements of people, and stimulated the production of poultry. As more chickens are produced to feed exploding urban populations – China produces 13 billion chickens today, but only 12.3 million in 1968 -- the greater the possibility the virus will jump from birds to humans (Osterholm, 2005: 37 and Garrett, 2005: 10-11). When that happens, the consequences for humanity will be catastrophic. Human cases so far have a 30-70 percent mortality rate (Garrett, 2005: 14). With no immunity humans are vulnerable to a pandemic that could rapidly kill millions of people. Maximum global vaccine production is estimated at

300 million, a fact that raises the disturbing question of whom among nearly 7 billion people would get the vaccine, assuming we can develop one that responds to the complexities of H5NI (Garrett, 2005: 17-18). Our experience with SARS, which only lasted 6 months, teaches that the economic costs of a much larger event could be staggering. SARS cost the Asian-Pacific region $40 billion (Osterholm, 2005: 28). It is estimated that a H5N1 pandemic would kill 142.2 million people and cost $4.4 trillion in lost GDP (Osterholm, 2007: 48). A H5N1 outbreak would shut down trade, causing a collapse in the tightly coupled system of "just-in-time," globalized production. The influenza would strike labor and management, causing organizational hierarchies to falter. As quarantines are established, schools and factories would close. The health-care system, already stressed even in the most developed countries, would collapse (Osterholm, 2005 and Greger, 2006).

The fuel, productive, climate, environmental, and disease challenges facing humanity are compounded by demographic factors. In a few generations global population will be 9.5 billion people. The 2 billion additional people will live in a global South already struggling to survive. A dramatic jump in the megalopolis phenomena is happening. In 2007, demographers predict the majority of humanity will live in cities, a world historical milestone in the human experience. It is estimated that 70 million people a year migrate from rural to urban. That's 1.4 million individuals a week, 200,000 a day, 8,000 an hour, or 130 per minute. At this pace, by 2030 there will be 3 billion urban squatters. If we are to house them, 35 million new houses need to be constructed each year, about 1 every second (Neuwirth, 2006: xiii). Analysts like Mike Davis do not hesitate in calling our cities the dumping grounds for surplus population, as urbanization is defined by the slum phenomena (2006: 174-198). Today's Mexico Cities are more common, taxing the limits of weak nation-states to cope. Global South demographic growth aggravates ecological problems, and accelerates the depletion of scarce resources. Provisioning clean water and sanitation in the mega-cities already stresses urban systems and their populations (McGranahan and Satterthwaite, 2007). Lack of potable water is becoming more extreme, and some cities, such as El Paso-Ciudad Juárez are predicted to meet unsustainable scarcity by 2025 (*U.S. Water News Online*, 1998). Suketu Mehta estimates half of Mumbai's 13 plus million people do not have toilets or sewage. They produce 2.5 million kilos of excrement each day. As it evaporates, suspended fecial dust enters the air and is breathed by all of Mumbai's inhabitants (2004). Lack of basic infrastructure will increase in the 21st century as more global South cities become megalopolises. In China, 114 million people have migrated to cities; another 250 to 300 million will follow in the decades ahead (Pei, 2005: 57). In the last eleven years the number of Chinese cities with 1 or more million inhabitants has grown to 41. China currently has 16 of the world's 20 most populated cities (Lee, 2007: 9). Shanghai, in 2005, built more building space than exists in all of New York City's offices, and every month China adds urban infrastructure equal to Houston, Texas, the 4th largest city in the United States (Hughes and Sawin, 2007: 93). Consequent increases in resource consumption and epidemic factors come with such dramatic transitions, as well as the problem of reproducing complex urban systems in a stressed world.

Those who are not absorbed by cities continue their migrations, most often to the global North. Colin Powell informs that at least 180 million people do not reside in their countries of birth. The income they send home, totaling about $93 billion, outpaces "official" development funds by $16 billion (2005: 32). Such incomes often constitute the second and third most important items to the gross domestic product in the global South. Future survival in the global South will depend more on migration, while the global North will continue apartheid approaches, such as those not so subtly advocated by nativists like Samuel Huntington, to keep migrants out (2004; 2004a). The collision between increasing levels of migration and deeper host country restrictions means the current humanitarian crisis facing migrants will most likely worsen. (Walter, 2006b: 117-139).

Plague and famine, as we know from the human made tragedy of Africa, are additional components to the demographics of a complex system in collapse. Demographic stress manifests itself in genocides and resource wars. As Michael Klare shows, millions have perished since the end of World War Two in vicious civilian conflict (2001). Competition for scarce, non-renewable resources leads agents of developed world consumers to interact with local dynamics of failed states, ecological stress, and extreme poverty in causing these deadly wars (Tabb, 2007; and Ross 2003). Over 5 million people died in these wars during the 1990s, while 6 million fled to other countries, and roughly 15 million were internally displaced. The proliferation of weapons of mass destruction makes these conflicts more dangerous and harder to contain within the geopolitical periphery.

Paul Kennedy clearly illustrates how global hegemons succumb to decline and collapse because of imperial overreach (1987). History teaches that increased military expenditures required for managing complex global systems undermine the actual foundations making the great powers great. History also teaches that during moments of imperial overreach major shocks to the global system result. Less

understood is the connection between overreach and the inability to manage the vexations of systemic collapse, and there is very little doubt that it's already very expensive. The United States has spent nearly a trillion dollars on military operations since September 11, 2001, and there is no foreseeable end to that money drain. Compare these costs of empire to the $15 billion, five-year program pledged by the Bush administration to fight AIDS, tuberculosis, and malaria, and we begin to see how overreach prevents us from attacking the real mass killers (Garrett, 2007: 19). With 26 million deaths and 40 million current afflictions, AIDS has killed far more people than Saddam Hussein. The 2006 discretionary Department of Defense budget is a staggering $419.3 billion, which constitutes nearly half of the entire discretionary budget of $840.3 billion. The military's budget is roughly equivalent to the current United States federal deficit, and represents an unhealthy portion of its GDP. The cost of empire means less money is spent on crucial domestic infrastructure, a truth painfully revealed by Hurricane Katrina and the Interstate 35 bridge collapse in Minneapolis. Such investments are necessary for competing in the globalized economy, especially with countries and regions that are not making comparable military expenditures.

Transitions in the global system's hegemonic power are moments of great instability and danger (Mahbubani, 2005: 50). The last transition from Great Britain to the United States came with two global wars that killed millions of people. As the center of the global capitalist system increasingly moves away from the United States, uncertainty and stress in the complex system of international finance, trade, production, and wealth increase. Reasonable people think Asia is becoming the next geographic center of global capitalism. Jeffrey Sachs, for example, estimates that by 2050, China's economy might be 75 percent bigger than the US economy (Fishman, 2006: 17). By 2003, $450 billion of foreign money entered the Chinese economy. Much of it flows from the United States as we consume vast quantities of Chinese production. China, in 2004, had a $480 billion stake in US securities markets (Fishman, 2006: 265). China is the second largest importer of oil, constituting 31 percent of the world's oil demand growth. Its 9 percent economic growth rate equates to a need for 1 million barrels of oil every day (Fishman, 2006: 117). This oil demand finds China aggressively forming close partnerships with oil producers in the Middle East, Africa, and Latin America, often with enemies of the United States. China negotiates trade and energy deals throughout the world, quietly positioning itself as a global economic power. Quality statesmanship is required to navigate the potential for serious military conflict in the years ahead, especially as the United States and China compete for scarce resources, investment opportunities, and markets (Jianhai and Zweig, 2005).

The current sub-prime interest rate global financial crisis demonstrates several key points about the structural vulnerability of the global economy. First, keeping the global system in growth phase is accruing huge costs to the system. The economy is in overshoot, and we are extending more and more inputs to keep it alive. We are in a classic positive feedback loop, one defined by the "growth imperative" generating steeply negative returns that push the system deeper into collapse. The costs for reproducing the global economy are so immense they make the system unsustainable. The United States currently serves as the consumer of last resort, a role that sustains global economic growth, especially in China and India. This system rests upon an unending capacity of the US consumer to increase debt, an unsustainable proposition. Average credit card debt balance per cardholder is $4,956 at end of 2005, and unpaid credit card balances at end of 2005 reached $838 billion (Foster, 2006). Other significant ticking time bombs lurk within the system. The aging population in the global North combined with its population decline means a major crisis in retirement is right around the corner (Barnett, 2004: 206-214; and Ghilarducci, 2006). Matching the pension problem is the growing crisis in heath care and insurance in the global North.

These structural problems can merge with larger systemic problems in overwhelming the economy. The end of oil's transformation in energy, production, and food systems carries heavy price tag. Even if the global North can afford the transition, billions upon billions live in areas of the world that have no ability to pay for the new technologies, production, and distribution systems. Increased natural disasters are taxing the system's ability to pay for them. Caring for vulnerable populations might be well beyond the capacity of humanity to fund. The cost of war keeps increasing, and pulls crucial funds from other systemic needs, such as the transition away from oil and contending with natural disasters. There is a wide range of costs not calculated in how capitalism balances its accounts, especially when measured by GDP. These costs include: ecological destruction, poor health conditions, resource depletion, and pollution. High levels of systemic stress combined with high costs, especially in a tightly coupled globalized economy, mean the system's resilience is compromised.

When confronted with the "Perfect Storm," optimists may think that we need to focus on changing course. This view, however, is part of the problem. We have long ago passed the time when we could

have changed course. Our complex system carries immense momentum generated by the positive feedback loops driving it (Meadows, Randers, Meadows, 2004: 141-145). We are a freight train attempting to stop quickly when its speed and weight will carry it into doom. It is foolish to only speak of alternatives. Instead, what we need is sober and sophisticated discussion about preparing as best we can for catastrophic collapse.

A core problem exists in our ability to understand the meaning of the "Perfect Storm" for the human experience. The systems we have designed are so complex we have trouble understanding how they work in totality. As Homer-Dixon explains in *Ingenuity Gap*, we are good at seeing the parts of the system, but falter with the bigger picture (2000: 171-187). In part, this problem reflects the consequence of fragmentation of knowledge within academia, as well as the specialization needs of capitalist society. Consequently, we conflate symptoms for causes, and tend to see problems as isolated, unfortunate occurrences within an otherwise healthy system. Few people frame discussion of Hurricane Katrina, the Tsunami, the Iraq War, China's emergence, AIDS, mass migration, genocides, or September 11th as interrelated outputs of a complex system that is in the process of collapse. Until the bigger picture starts to shape our discussions, we will have immense troubles surviving the "Perfect Storm."

More troublesome, the failure to frame the bigger picture distorts our ability to devise public policy that can reduce the impact of the "Perfect Storm." Very powerful analytical tools, such as data mining, can do wonders in navigating catastrophe, but they are only as good as the information we put in, and that information is flawed if we fail to understand what the complex system is doing. Likewise, misuse of tools from the social and hard sciences can exacerbate an immense problem already generated by the early salvos of the "Perfect Storm," that being global apartheid.

As the complex system continues to become unglued, the historical distinctions between rich and poor, racial minority and majority, men and women, the global North and South will intensify. Social and economic injustice will define how we respond to particular crises and the overall condition of humanity during collapse. We will have to decide among the 7 to 9 billion people who gets medicine, water, heat, shelter, and food. We will decide who lives and who must die. As environmental justice scholars demonstrate, we already make these decisions, and the results are brutal for much of humanity (Agyeman, 2005). An estimated 2.7 billion people survive on $2 a day, while 1 billion children face severe nutritional deprivation (Homer-Dixon, 2006: 186-187). Yet, we pretend these decisions are not made, and we ignore the brutal mechanisms of repression and exclusion required to enforce these decisions. As catastrophic collapse deepens, our global apartheid will become more severe. The walls we have already built and militarized in places like Palestine and the United States and Mexican border will become ever more present. Sophisticated technologies will be horded by the haves and deprived for the have-nots. Ever increasing segments of the global population will be excluded from health care, food, water, shelter, and work. Exactly what this reality will mean to the human condition is hard for us to imagine. It means the Enlightenment's faith in the perfectibility of the human condition will give way to a new vision for humans, one rooted in the basic need to survive as a species. The conservative view of the state of nature is well positioned to further manipulate our darker angels.

References

Agyeman, Julian. 2005. *Sustainable Communities and the Challenge of Environmental Justice*. New York: New York University Press.

Assadourian, Erik. 2006. "Global Ecosystems Under More Stress." In: *Vital Signs: 2006-2007. The Trends that are Shaping our Future*. New York: W.W. Norton/Worldwatch Institute.

Azar, Christian. 2005. "Emerging Scarcities: Bioenergy—Food Competition in a Carbon Constrained World." In: R. David Simpson, Michael A. Toman, and Robert U. Ayres. Editors. *Scarcity and Growth Revisited: Natural Resources and the Environment in the New Millennium*. Washington, DC.: Resources for the Future.

Barnett, Thomas. 2004. *The Pentagon's New Map: War and Peace in the Twenty-First Century*. New York: Berkley Books, 2004.

Berry, Thomas. 1988. *The Dream of the Earth*. San Francisco: Sierra Club Books.

Brinkley, Douglas. 2006. *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast*. New York: Harper Collins.

Chafe, Zoë. 2006. "Disappearing Mangroves Leaves Coasts at Risk." In: *Vital Signs: 2006-2007. The Trends that are Shaping our Future*. New York: W.W. Norton/Worldwatch Institute.

Clark, Robert. 2002. *Global Awareness: Thinking Systematically About the World*. New York: Rowman and Littlefield Publishers.

Cooper, Christopher and Robert Block. 2006. *Disaster: Hurricane Katrina and the Failure of Homeland Security*. New York: Times Books.

Davis, Mike. 2006. *Planet of Slums*. New York: Verso.

Development, Concepts, and Doctrine Centre. 2007. *Global Strategic Trends.* United Kingdom: Ministry of Defense.
Diamond, Jared. 2005. *Collapse*: *How Societies Choose to Fail or Succeed*. New York: Viking.
Dyson, Michael Eric. 2005. *Come Hell or High Water: Hurricane Katrina and Natural, Racial and Economic Disasters*. Cambridge, MA: Basic Civitas.
Emanuel, Jerry. 2005. "Increasing Destructiveness of Tropical Cyclones Over the Past Thirty Years." *Nature*. 436 (August): 686-688.
Farrell, Alexander and *et al*. 2006. "Ethanol Can Contribute to Energy and Environmental Goals." *Science*. 311 (January): 506-508.
Fishman, Ted. 2006. *China Inc.: How the Rise of the Next Superpower Challenges America and the World*. New York: Scribner.
Foster, John Bellamy. 2006. "The Household Debt Bubble." *Monthly Review* Vol. 58; No. 1 (May): 7-11.
Galeano, Eduardo. 2005. Translated by Mark Fried. *Upside Down World: A Primer for the Looking-Glass World*. New York: Picador.
Garrett, Laurie. 2005. "The Next Pandemic." *Foreign Affairs*. 84;4 (July/August): 3-23.
_____ . 2007. "The Challenge of Global Health." *Foreign Affairs*. 86;1 (January/February): 14-38
Geertz, Clifford. 2005. "Very Bad News." *The New York Review of Books*. (March 24): 4-6.
Ghilarducci, Teresa. 2006. "The End of Retirement." *Monthly Review* Vol. 58; No. 1 (May): 12-27.
Greger, Michael. 2006. *Bird Flu: A Virus of Our Own Hatching*. New York: Lantern Books.
Homer-Dixon, Thomas. 2000. *The Ingenuity Gap*. New York: Alfred A. Knopf.
_____. 2002. "The Rise of Complex Terrorism." *Foreign Policy.* 128 (January/February): 52-62.
_____. 2006. *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization*. Washington, DC: Island Press.
Horne, Jed. 2006. *Breach of Faith: Hurricane Katrina and the Near Death of a Great American City*. New York: Random House.
Hughes, Kristen and Janet Sawin. 2007. "Energizing Cities." In: *2007 State of the World: Our Urban Future*. New York: W. W. Norton/Worldwatch Institute.
Huntington, Samuel. 2004. "The Hispanic Challenge." *Foreign Policy*. 141 (March/April): 30-45.
_____. 2004a. *Who Are We? The Challenges to America's National Identity*. New York: Simon and Schuster.
Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: The Physical Science Basis: Summary for Policymakers*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.
Jianhai, Bi and David Zweig. 2005. "China's Global Hunt for Energy." *Foreign Policy*. 84;5 (September/October): 25-38.
Kennedy, Paul. 1987. *The Rise and Fall of the Great Powers*. New York: Vintage Books.
Klare, Michael. 2001. *Resource Wars: The New Landscape of Global Conflict*. New York: Henry Holt and Company.
Korten, David. 1999. *The Post Corporate World: Life After Capitalism*. West Hartford, CT: Kumarian Press.
_____ . 2001. *When Corporations Rule the World*. Second edition. West Hartford, CT: Kumarian Press.
Lee, Kai. 2007. "An Urbanizing World." In: *2007 State of the World: Our Urban Future*. New York: W. W. Norton/Worldwatch Institute.
Mahbubani, Kishore. 2005. "Understanding China." *Foreign Policy*. 84;5 (September/October): 49-60.
McGranahan, Gordon and David Satterthwaite. 2007. "Providing Clean Water and Sanitation." In: *2007 State of the World: Our Urban Future*. New York: W. W. Norton/Worldwatch Institute.
McKibben, Bill. 2004. "Crossing the Red Line." *The New York Review of Books*. (June 10): 32-36.
_____. 2007a. "Warning on Warming." *The New York Review of Books*. (March 15): 44-45.
_____ . 2007b. "This April… Red + Blue Go Green." *In These Times*. (April): 20-23
Meadows, Dennis, Donella Meadows, and Jorgen Randers. 2004. *Limits to Growth: The 30-Year Update*. White River Junction, VT: Chelsea Green Publishing Company.
Mehta, Suketu. 2004. *Maximum City: Bombay Lost and Found*. New York: Alfred A. Knopf.
Millennium Ecosystem Assessment. 2005. *Living Beyond our Means: Natural Assets and Human Well-Being*.
Moberg, David. 2007. "Biofuels: Promise or Peril?" *In These Times*. 31; 4 (April): 24-26.
Neuwirth, Robert. 2006. *Shadow Cities: A Billion Squatters, a New Urban World*. New York: Routledge.
Osterholm, Michael. 2005. "Preparing for the Next Pandemic." *Foreign Affairs*. 84; 4: (July/August): 24-37.
_____ . 2007. "Unprepared for a Pandemic." *Foreign Affairs*. 86; 2 (March/April): 47-57.
Perrow, Charles. 1984. *Normal Accidents: Living with High-Risk Technologies*. New York: Basic Books.
Pei, Minxin. 2005. "Dangerous Denials." *Foreign Policy*. 146 (January/February): 56-58.
Powell, Colin. 2005. "No Country Left Behind." *Foreign Policy*. 146 (January/February): 28-35.
Public Citizen. 2005. *Fishy Currency: How International Finance Institutions Fund Shrimp Farms*.
Rich, Bruce. 1994. *Mortgaging the Earth: The World Bank, Environmental Impoverishment, and the Crisis of Development*. Boston: Beacon Press.
Rifkin, Jeremy. 2003. *The Hydrogen Economy*. New York: Tracher/Penguin.
Roberts, Paul. 2005. *The End of Oil: On the Edge of a Perilous New World*. New York: Houghton Mifflin Company.
Ross, Michael. 2003. "The Natural Resource Curse: How Wealth Can Make You Poor." In: Ian Bannon and Paul Collier. Editors. *Natural Resources and Violent Conflict: Options and Actions.* Washington, DC.: The World Bank.
Runge, C. Ford, and Benjamin Senauer. 2007. "How Biofuels Could Starve the Poor." *Foreign Affairs*. 86;3 (May/June): 41-53.

Schwartz, Peter and Doug Randall. 2003. "Imagining the Unthinkable: An Abrupt Climate Change Scenario and Its Implications for United States National Security Policy."

Tabb, William. 2007. "Resource Wars." *Monthly Review*. 58;8 (January): 32-42.

U.S. Water News Online. 1998. "Southwest Cities Will Face Future Water Shortages." (November). *http://www.uswaternews.com/archives/arcconserv/8soucit11.html*

Waldrop, M. Mitchell. 1992. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Simon and Schuster.

Walter, Jonathan. Editor. 2006a. *World Disasters Report: Focus on Neglected Crises*. Geneva: International Federation of Red Cross and Red Crescent Societies.

_____ . 2006b. "Death at Sea: Boat Migrants Desperate to Reach Europe." In: *World Disasters Report: Focus on Neglected Crises*. Geneva: International Federation of Red Cross and Red Crescent Societies.

Wilson, Edward O. 1992. *The Diversity of Life*. Cambridge: Harvard University Press.

Yergin, Daniel. 1991. *The Prize: The Epic Quest for Oil, Money, and Power*. New York: Simon and Schuster.

About the Author

Dr Glen Kuecker

Glen Kuecker is an associate professor of Latin American history at DePauw University. He has a BA degree from St. Olaf College and the Ph.D. from Rutgers University. He conducts research and writing on 19th Century Mexican urban history, and contemporary social movements. Professor Kuecker is co-founder of the Intag Solidarity Network, which runs a human rights program in Ecuador. He is co-founder of the Canary Institute, which undertakes grassroots research about catastrophic collapse. He also collaborates with the Globalism Institute, RMIT University, Melbourne, Australia on sustainable community research. In writing this essay, Professor Kuecker thanks Jake Gross, Juan Pedroza, Charlie Carlin, and Rich Cameron for their comments on earlier drafts. Likewise, he thanks the readers for their critical comments. He acknowledges their contribution while recognizing limitations in his ability to fully incorporate their valued critiques. Finally, this essay is inspired by the life and example of Santos Tele Tax.

THE INTERNATIONAL JOURNAL OF ENVIRONMENTAL, CULTURAL, ECONOMIC AND SOCIAL SUSTAINABILITY

Please visit the Journal website at http://www.Sustainability-Journal.com for further information:

- ABOUT the Journal including Scope and Concerns, Editors, Advisory Board, Associate Editors and Journal Profile
- FOR AUTHORS including Publishing Policy, Submission Guidelines, Peer Review Process and Publishing Agreement

SUBSCRIPTIONS
The Journal offers individual and institutional subscriptions. For further information please visit http://ijs.cgpublisher.com/subscriptions.html. Inquiries can be directed to subscriptions@commongroundpublishing.com

INQUIRIES
Email: cg-support@commongroundpublishing.com