paper 4

DISCUSSIONS ON KEYNOTE PAPER:
CLIMATE CHANGE AND THE ADAPTATION DEFICIT

1. MEASURING THE ADAPTATION DEFICIT

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How do we move adaptation into the mainstream? It has been proposed that quantifying adaptation is a necessary measurement to begin mainstreaming adaptation into decision making. The suggested approach, based on losses, is not an index of adaptation, but an indication of the outcome. A loss index, such as rising insurance claims, indicates the degree to which we have not yet adapted, or the adaptation deficit. It may gain favour as it is an easily understood measure, and it suggests a target that is isomorphic to the mitigation of greenhouse gases (reduce losses by a fixed percentage). Interestingly enough, the UN set a target of a 50% reduction in losses to natural hazards during its Disaster Reduction Decade, only to witness an increase in the amount of destruction due to hazards.

A true index of adaptability would have to encompass a property of the system that leads to increasing vulnerability to weather hazards. From a systems perspective there are probably several measures (diversity, redundancy, connectedness and resource potential). This would build on the work of Holling (1986) in developing the adaptive cycle and its application in both an ecological and social context. Although this is the best measure from a strictly scientific perspective, these indices are not as well understood by the public or policy makers, may be difficult to quantify and agreement on a single index of a system measure is extremely difficult.

A third alternative is to base a measure on the degree of innovation for coping with variability and change. Innovation refers to developing new strategies or technologies or reviving old ones and using them in a novel fashion. Green roof technology represents one example of using an old strategy to cope with new environmental issues. Nanotechnology represents a totally new innovation that can be used in the development of new technologies to mitigate the damage associated with extreme weather events. Measuring innovation is extremely difficult, but it may be possible to develop a measure of the capacity to innovate. The proposed method is based on the COBWEB simulation model, developed to explore how systems respond to environmental variability and change.

A simple simulation model has been constructed to illustrate how strategies evolve in a system of autonomous agents. In the program Complex Organization and Bifurcation Within Environmental Bounds (COBWEB) each agent's strategy is a vector of 8 dimensions, consisting of only 1's and 0's. Any particular combination will determine a few simple actions (movement, consumption and reproduction). Those strategies that are best suited for the environment will survive and reproduce, the others will die out. Depending on the environment, it is expected that a different combination of 1's and 0's would allow for varying degrees of success. Once the system has selected those strategies that work, it is possible to change the environment and observe if these strategies are effective at adapting to change.

A strategy is considered to be successful if it can stay in the environment through reproducing itself. However, for the system to survive, it has to allow for innovation in order to cope with changes in the environment. In COBWEB, innovation occurs when strategies can change. Change can occur via mutation at reproduction, either asexual or sexual, or through sexual reproduction by combining half of its string of 1's and 0's with half the string from another agent. Both of these methods allow for innovation to occur.

Innovation can also occur by expanding the dimensions of the strategy. The program allows for the strategies to be augmented at every time step through new information that is gathered from the environment, i.e. through observation, or from communicating with other agents. Both of these activities expand the dimensionality of the vector. COBWEB has been used to conduct experiments with and without communication and new environmental information. The probability of survival and reproduction favoured new information by a very small margin. However, with new information, the agent was able to survive much longer and produce many more offspring.

Innovation has been recognized as an important aspect of adaptation, and this has been illustrated with the COBWEB simulation model. The COBWEB simulation also indicates how the capacity for innovation can be measured.

COBWEB has various quantitative parameters that allow for more change or less change to occur in an agent's strategy. These include the rate of mutation, the probability of communication, the size of the memory for new information and/or communication and the probability of sexual reproduction. Both probabilities and binary strings lend themselves to measurement in an information-theoretic context. Information theory can provide a measure of uncertainty in terms of the number of choices available in a situation, the larger the measure, the more choice available.

Translating this measure into something that is as clear as loss remains a challenge. If we conduct an inventory of what is required to expand our range of choices it will include income, education, experience, ability for communication and observation and other aspects of society that will overlap with various systems-theoretic measures such as diversity and redundancy. The key difference is that this measure of adaptability, i.e. the capacity to innovate, has to be expressed in terms of our ability to choose. It may reduce to a few simple proxy measures, such as the average levels of education, income and funding for research in all disciplines, or it may be expressed as a new index, such as our ability to choose.

This measure of adaptability can complement an outcome, such as insurance losses. However, an outcome does not represent our ability to adapt rather it represents our failure to use our capacity for innovation to adapt to climate change. Insurance loss reduction may be a target to aim for, but just as an archer requires a bow and arrow and practice to hit a target, reducing insurance losses will also require various strategies and perhaps experiments with different technologies.

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2. NATURAL DISASTERS AND THE GROWING GAP OF VULNERABILITY

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Natural disasters occur when a natural event triggers some vulnerability within the socio-economic fabric of our society, and results in damage exceeding the ability of the affected community to recover without outside assistance. These sorts of events have been affecting humankind throughout our history and have become part of our myth, legend and religions.

In recent decades data on the number and costs of natural disasters (see Figure 1) have shown increasing trends (Munich Re, 2003; Etkin et al, 2004). There has been a good deal of discussion regarding the reasons for this. Population growth and increases in wealth account for part of it, but case studies have shown that many disasters have occurred because of increases in social vulnerability, and this is thought to lie at the root of the problem. In spite of increases in knowledge and technology, they have not been able to solve the disaster problem.

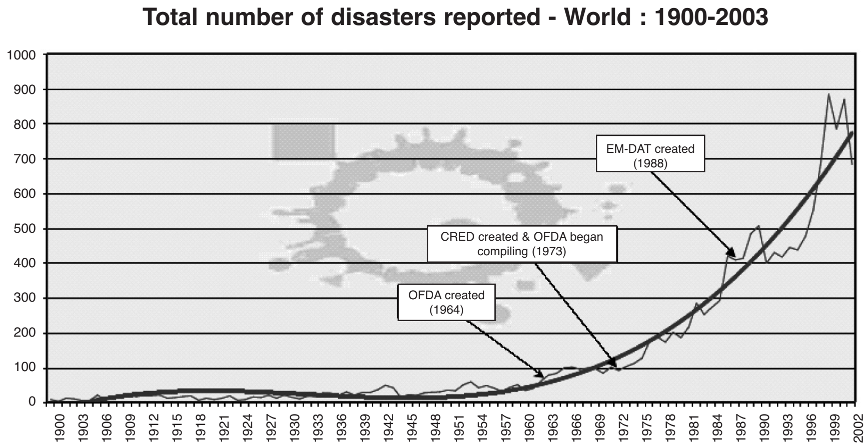

FIGURE 1

Number of disasters in the world from 1900-2003. *Source: Centre for Research on the Epidemiology of Disasters (CRED), 2004.*

Various authors have discussed the issue of how trends in modern society can increase vulnerability to extremes.

In 'The Labyrinth of Technology' Willem H. Vanderburg notes "The fundamental contradiction in technological and economic growth... At the micro level, we find technical and economic rationality; at the macro level, technical and economic irrationality". In 'The Perception of Risk' Paul Slovic states that "We live in a world in which information … has reduced our susceptibility to accidents and diseases at the cost of increasing our vulnerability to massive social and economic catastrophes". In 'Normal Accidents' Charles Perrow argues in complex & tightly coupled systems, accidents are a fundamental property of the system, and all of them cannot be prevented. Thus - catastrophes are therefore unavoidable. In 'Risk Society: Towards a New Modernity' Ulrich Beck suggests that society is undergoing a transition, from one based upon capital and production, to one mainly concerned with risks associated with a technological society. He argues that "A risk society is a catastrophic society, where exceptional conditions threaten to become the norm." 'Disasters by Design' by Dennis Mileti overviews the second U.S. national assessment of natural hazards. He concludes that "Too many of the accepted methods of coping with hazards have been shortsighted, postponing losses into the future rather than eliminating them". In part, this is because "People have sought to control nature and to realize the fantasy of using technology to make themselves totally safe". 'The Ingenuity Gap' by Thomas Homer-Dixon is explicit about our adaptation deficit, arguing as follows – "I'm convinced that if we … allow the complexity and turbulence of the systems we've created to go on increasing, unchecked – these systems will sometimes fail catastrophically…. I believe this will be the central challenge – as ingenuity gaps widen the gulfs of wealth and power among us, we need imagination, metaphor and empathy more than ever, to help us remember each other's essential humanity".

Essentially, these insights argue that many strategies used to mitigate risk only transfer it to the future (Etkin et al., 2004). In part, the argument for this is that many mitigative strategies have the unintended result of people and communities engaging in excessive risk taking behavior, such that their risks to extremes beyond the design standards of their infrastructure or land use planning become so large that the risk reductions achieved to more commonplace events is overwhelmed in comparison (Etkin, 1999). This transfer of risk is illustrated in Figure 2.

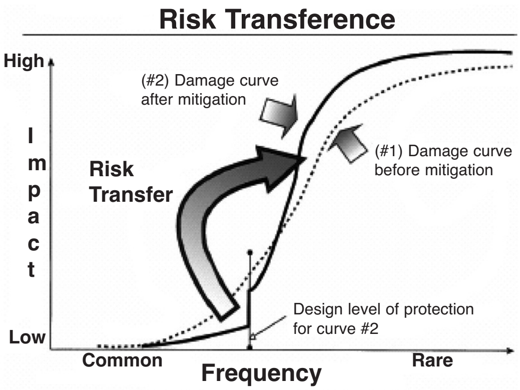

FIGURE 2

Risk transference.

The result of environmental degradation, excessive risk taking and short term values is a widening adaptation deficit – a gap between our ability to address the problems we face as a civilization and species and the risks those problems generate.

When development or mitigation improperly assesses the risk of rare high-consequence events, risk is transferred from the more common hazards to extreme events that exceed design criteria. Long-term vulnerability can thereby be increased.

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3. NATURAL CAPITAL AND THE ADAPTATION DEFICIT

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To calculate the adaptation deficit in many areas of the human economy, it becomes a matter of gains or losses, or costs or benefits. These gains or losses are calculated using traditional economic theories that fail to recognize the real or "true" costs of adaptation measures as they affect the value of ecosystems and biodiversity – what is often referred to as natural capital. The gains or losses in the value of natural capital as affected by adaptation measures need to be captured in the accounting of the adaptation deficit.

In traditional economics, capital is a manufactured (human-made) means of production, that is, the tools, machinery, buildings and so on to generate profits. However, this approach also views land and nature as a source of materials and a source of services that are provided as "free" goods. Natural capital is the living and active ecosystems that yield a steady flow of useful goods and services. It is not necessarily the use of the Earth's natural capital that is troublesome, but the failure to understand what its use means, to account properly for it and to invest in it.

Decisions about the exploitation of natural capital are evaluated ordinarily according to criteria that take for granted that all economic values of natural capital are known and reflected in the prices the resources bring to the open market. These decisions also assume that markets are undistorted by subsidies and externalities; and that the proceeds from the extraction and sale of resources are actually reinvested in other productive capital, not just squandered.

The national accounts of nations fail to accurately describe changes in the quality and quantity of natural capital stocks, in contrast to the way stocks of manufactured capital are treated. Three changes have been proposed to address the shortcomings of national accounts:

1. expanding the asset boundary to include the now uncounted environmental and natural resources;
2. redefining national income to include the value of recreation, aesthetics, biodiversity and non-use benefits; and
3. recognizing the contribution process of environmental services such as waste absorption.

However, no national accounting system anywhere is yet fully adequate to the task. Traditionally, the Gross National Product (GNP) is the market value for all goods and services produced within a nation in a given time period – the accounting measure that is used when quantifying the adaptation deficit. GNP is supposed to gauge human welfare but there are major perversions such as when a major oil spill that damages the ecology of a coastal zone increases a country's GNP because the clean-up efforts are calculated in the accounting while the ecological damage is not. There have been some attempts to address the problem with the GNP such as the Index of Sustainable Economic Welfare (Daly and Cobb, 1989) that incorporates income distribution, net capital growth, natural resource depletion and environmental damage, unpaid household labour, streets and highways, health care, education, and national advertising in national accounting measures. And the Human Development Index (HDI) developed by the UN Human Development Program goes beyond per capita wealth to life expectancy, quality of nutrition, education, access to water and sanitation, distribution of wealth, freedom index, etc.

Some suggest that pricing the world cannot be done on a moral basis. Species have a right to exist, period, and attempting to assign values to them is meaningless. Markets clearly ignore certain important values of our society, and no market value can be given to a species' role as a component of an ecosystem. This view ignores the fact that dollar values are a useful if incomplete measuring stick for decision-making. It permits reasonable comparisons. Economists say that it yields a quantified measure of peoples' preferences.

Attempts have been made to put a market value on natural capital and its goods and services. This is done through what economists call contingent valuation, or what is known as the "willingness to pay" approach. Contingent valuation simply asks people what they are willing to pay to forgo a benefit or tolerate a loss. There are many problems inherent in this approach, but it manages to place a market value on things that we humans traditionally take for granted and do not account for. Costanza et al (1997) estimated that the total value of all the Earth's ecosystem services stemming from natural capital totaled $33 trillion per year, a figure that exceeds the sum of the world's gross national products. Others have called the $33 trillion per year a "serious underestimate of infinity", as without the services from natural capital, humans would not exist.

An effective adaptation deficit will be difficult to calculate because of the inherent difficulties now of accounting for environmental sustainability and the earth's natural capital.

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4. ADDRESSING THE ADAPTATION DEFICIT THROUGH FUNDING

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The UNFCCC calls on developed country Parties to assist developing country Parties that are vulnerable to the adverse effects of climate change in meeting costs of adaptation. At the third conference of the parties (COP) meeting adaptation as an expenditure goal was first cited. At that meeting, the UNFCCC Parties agreed to the Kyoto Protocol, which defined the Clean Development Mechanism (CDM). Article 12 of the Kyoto Protocol defines the CDM and it performs a three-fold function to:

- Assist non Annex-I countries in achieving sustainable development;
- Contribute to the ultimate goal of the convention i.e., stabilization of greenhouse gas concentrations in the atmosphere; and
- Help Annex I countries comply with their emission reduction commitments.

Within the provisions of the CDM, financial resources are to be made available to assist developing countries that are particularly vulnerable to the adverse effects of climate change and associated sea level rise to meet the costs of adaptation. At the COP 4 held in Buenos Aires in 1998, a decision was adopted that funding could be made available to developing countries for the preparation of adaptation activities.

As a result of the broad political compromise reached in July 2001, Governments decided to establish three new funds to assist developing countries with adaptation activities at UNFCCC COP 7. The following three funds are part of the Marrakech Accord.

The Special Climate Change Fund is operated by the GEF with guidance to the convention, to finance adaptation, technology transfer, energy, transport, industry, agriculture, forestry and waste management and activities to assist oil-exporting countries diversify their economies. Dessai and EURONATURA (2002) argue that ultimately, the prioritization of activities under this fund will be based on politics because of the nature of the Convention process.

The Least Developed Countries Fund is operated by the Global Envionmental Facility with guidance to the Convention, to support National Adaptation Programmes of Action (NAPA). The NAPA established a set of guidelines for communicating urgent and immediate needs of the Least Developed Countries (LDCs) to adapt to climate change. It identified a set of criteria for selecting priority activities such as: life and livelihood, human health, food security and agriculture, water availability, quality and accessibility, essential infrastructure, cultural heritage, biological diversity, land management, other environmental amenities and other socio-economic factors, especially poverty. The Marakesh Accords of COP 7 launched an LDC Expert Group to support them in their preparation and implementation of the NAPAs.

The Kyoto Protocol Adaptation Fund is resourced by the share of the proceeds on CDM project activities, to finance concrete adaptation projects and programs.

All of these funds will be necessary to help less developed countries meet their adaptation deficits.

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