The Reform of Global Environmental Governance: Insights from Complex Systems Theory

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Abstract

Drawing on complex systems theory this paper argues that global environmental governance requires elements of both conventional top down, centralized, hierarchical management and complex adaptive management that relies on decentralization, flexible institutions, a range of knowledge and a broad suite of tools including market and voluntary mechanisms.

Introduction

> '*At the present time we lack the concepts and the institutional arrangements for this kind of management. By "management" I do not refer here to the technical, legal and administrative ability to direct, say, a system of water quality standards or to control the use of pastureland. I refer, rather, to arrangement of the decision-making process – to organize the necessary research and analysis and monitoring functions, formulation alternative courses of action, and evolving procedures through which conscious choices can be made in the fullest possible knowledge of their consequences….'*[1] Maurice Strong, 1973

Despite almost four decades of practical experience since the Stockholm conference, it is clear that we still lack effective systems of global environmental governance and that the existing suite of institutions, treaties and norms are increasingly unable to deal with complex environmental threats. These growing inadequacies provide an impetus to re-examine systems of global environmental governance in new and innovative ways. Drawing on complex systems theory theories this paper offers a new perspective on how to reform global environmental systems.

Global environmental institutions, treaties, norms and procedures have evolved from consensus based negotiations. Far too often the desire to reach agreement – any agreement, often in the pre-dawn hours of the last day of an important negotiation has led to compromises that seek to please everyone but reflect the lowest common denominator and frequently lead to the adoption of institutions, procedures, and norms that inhibit rather than enhance capacity to address global environment challenges.

Take for example, the United Nations Conference on the Human Environment, held in Stockholm, Sweden, from June 5-16th 1972. This conference marked the emergence of international environmental law and systems of global environment governance. By almost all measures it was a huge success. It was the first international meeting to address global environmental problems and its importance was underscored by a number of growing environmental problems particularly the regional pollution and acid rain problems of northern Europe. It was attended by 113 countries and led by the visionary Maurice F. Strong. It considered the need for a common outlook and for common principles to inspire and guide the peoples of the world in the preservation and enhancement of the human environment and it resulted in the establishment of the United Nations Environment Program (UNEP). UNEP had a combined mandate of monitoring global environmental conditions and catalyzing action in the United Nations system - and accelerated the establishment of environment ministries in both developed and developing countries. Yet, from its creation its limited legal

[1] (Strong, 1973)

mandate, lack of funds and location limited its ability to fulfill its mandate. In essence UNEP was a compromise between those who wanted a relatively powerful, top down, centralized system of global environmental governance, strengthened by a host of decentralized national bodies and those who feared effective institutions of global environmental regulation would limit economic growth or compromise state autonomy.

UNEP in its initial conception could have been a first step to an increasingly strong system of global environmental governance. From the outset, it was recognized that the primary institutions of global environmental governance would have to evolve with changing understandings of human and environmental relationships; and changing geo-political realities. In 1972, Strong argued that any systems of global environment governance 'envisaged should allow for the preliminary state of knowledge and understanding of environmental problems and should be flexible and evolutionary'.[2]

Unfortunately systems of global environmental governance have failed to evolve with new knowledge and circumstance. The same spirit of negotiated compromise that first led to the formation of UNEP – a body with a mandate but not the authority to coordinate global environmental governance – continues to result in sub-optimal institutions.

The purpose of this paper is to examine potential management approaches to the global commons and to identify the types of arrangements of institutions, treaties and authority that would enhance the effectiveness and the efficiency of the system of global environmental governance.

Management Paradigms

There is a wealth of literature on management approaches much of it applicable to global environmental management. The details are largely irrelevant in a paper of this scope. Therefore, while it is a little procrustean, I would like to simplify this broad literature into two management paradigms – convention and complex adaptive. The first is mechanistic, centralized, hierarchical, state-centric, top-down and aimed towards efficiency. The second is complex, decentralized, relying on diverse knowledge, a range of organizations and players and operates from the bottom up or middle to meet a range of needs.

Table 1: Two Management Paradigms

	Conventional	**Complex Adaptive**
Defining ontology	Mechanistic	Complex
Social organization	Centralized/hierarchical	Decentralized/distributed
Competence/Knowledge	High, technocratic, explicit	Mixed, experiential, tacit

[2] (*A/CONF.48/11, para. 7(d)*)

Scale of testing	Small number of large tests with high consequence of failure	Abundant small scale, safe-fail experimentation
Sources of legitimacy/power	Policy communities, management elites	Civil society, democratic action, markets
Social location	Top	Bottom and middle
Goal	Optimization of expected utility (according to explicit, well-defined preferences)	Satisficing of multiple, often conflicting, and sometimes incommensurable values

**Table taken from power point presentation by Tad Homer Dixon presented on April 25th, 2007 in Ottawa Canada reflecting on the need for complex adaptive management in military operation.*

These two management paradigms are often viewed as fundamentally opposite and mutually exclusive. Government bureaucracies, military organizations, and many large corporations are largely based on a conventional centralized, hierarchical management approach where as innovative cutting edge small companies like google and many civil society organizations are based on a complex adaptive management paradigm. While the existing systems of global environmental governance have incorporated elements of both paradigms, they lean towards the former and seem to adopt the later as a compromise. Ultimately the system which is neither conventional nor complex adaptive fails to benefit from the efficiency and enforceability of conventional management approaches and is equally unable to benefit from the resilience and adaptability of most complex adaptive management system. This is not to say that a hybrid approach to these two management systems is inherently detrimental. In fact this paper argues that incorporating elements of both management systems is not only possible but essential to effective global environmental governance but such a hybrid management approach must be consciously developed in order to maximize benefits rather than the result of half hearted compromise. In other words global environmental governance must embrace **both** conventional and complex adaptive management systems rather than **neither**.

The need for both Conventional and Complex Adaptive Management

The benefits of conventional, top down, hierarchical management systems are well known. They allow centralized coordination, strong focus, enforcement and in some instances efficiency. In contrast, complex adaptive systems are difficult to coordinate, diffuse and disparate and often inefficient but they are evolutionary able to predict and adapt to changes.

The risk is that current systems of global environmental governance lack such adaptive capacity in the face of a rapidly changing world. We currently face not only increasingly complex non-linear environmental challenges such as climate change and biodiversity loss, we also face changes such as the emergency of

Islamic Fundamentalism and governments run by fundamentalist religious movements such as Hamas or the Taliban, events such as 9/11 which have heightening global attention on issues of 'terrorism' and security, continued population growth in some regions particularly in countries such as India and China and yet also population declines in much of the world, notably in Russia and the Baltic states, due to lifestyle, and perhaps also to environmentally and chemically associated limits on fertility. While some of these seem far removed from questions of global environment governance they may in fact have ramification. Many countries resources and the resources of multilateral organizations are being diverted to focus on issues of security. The divide between the West and this fundamentalist Islam is resulting in military responses with significant environmental implications. Furthermore, an increasing number of players (governments) within the system of global environmental governance are occupied by fundamentalist Islamic groups that for the most part take an anti-technological stance (including both technologies associated with environmental ills and those considered solutions to environmental problems). Population declines may have significant implications for population trends, and hence for environmental welfare. They may also mandate additional linkages between those working on environmental, health and fertility issues. These are only a few of the emerging trends and threats global environmental systems must respond to. And such systems must act with foresight and flexibility to predict and adapt to emerging trends. The complex and rigid system of global environmental governance is unprepared to deal with these challenges.

Complex adaptive management is also mandated by increasingly complex and an increasingly volatile future. On top of growing recognition of non-linear ecological and socio-economic systems, there have also been fundamental societal changes such as the growing influence of technology, the rapid spread and dissemination of ideas, and the rapid flux of reproductive behaviour which react more tightly than ever before and further augment the complexity and variability in the development of future scenarios.

The standard response to such complexity is to add additional bureaucracy. There may be value in doing this. But this can make the system less capable of dealing with the very challenges the additional layer of bureaucracy is designed to deal with. Perhaps this can best be clarified by the work of a renowned Canadian ecologist Buzz Holling and his colleagues. Their research has demonstrated that all *living* systems (which includes ecosystems as well as human social or economic systems), naturally tend to become more complex, internally connected, and efficient over time, regardless of whether they need complexity to solve emerging problems. Eventually such systems becomes so well adapted to a specific range of circumstances—and so well organized as an efficient and productive system—that when a shock pushes it outside that range, it can't cope. And the system's high connectedness helps any shock travel farther and faster across the system as a whole. In other words, the complexity adds weight and minimized mobility and the system becomes more rigid and

brittle—less adaptive and less resilient. The system of global environmental governance may not yet be 'well organized as an efficient and productive system' but it is certainly increasingly complex and many of the proposals for global environmental reform seem to want to add to this complexity by adding bureaucracy and by promoting centralization, connections and efficiency – the exact conditions Holling predicts. This paper argues that there are diminishing marginal returns to this proposed increasing in both complexity and efficiency. It argues that the institutions, treaties and mechanisms of environmental governance should be evolutionary, adaptive and capable of responding to new challenges and opportunities without losing the benefits of conventional management systems.

The fundamental challenge is to assess how we implement a hybrid approach to global environmental management. This paper does not provide the answers but does lay out a few preliminary thoughts.

Defining Ontology: Mechanistic and Complex adaptive

The institutions, treaties and modalities of global environmental governance were created in the early 1970's when conventional, mechanistic management trends characterized most efforts at environmental control. In essence the system was issue based seeking to develop individual treaties for environmental problems largely viewed as discrete and separate. Despite some attempts at linkages, the system of global environmental governance remains issues based rather than fundamentally interconnected.

One of the results of such a mechanistic approach to global environmental governance is an inability to address complex environmental issues. Environmental issues which are technically and politically the easiest to resolve have been well addressed. Water quality in the Rhine, and in the North American Great Lakes, has been significantly improved. Chlorofuorocarbons, although still being used in many appliances, have been greatly reduced and are no longer being produced in Canada and US, leaded gasoline has disappeared from the Canadian market, and in many areas municipal sewage has improved (McNeil, 2001). Yet, some of the more complex environmental threats have not been addressed and the issue based nature of the global environmental system has resulted in treaty and institutional congestion.

In light of the desire to address each environmental issue separately there are now hundreds of international environmental agreements. A study conducted in 1992 identified more than 125 separate international environmental regimes[3] and it has been estimated that five additional environmental agreements have been concluded on average per year thereafter[4]. This has led to what is

[3] (Sand, 1992; Charnowitz, 1996)
[4] (Beisheim et al, 1999, 350-351)

commonly referred to as treaty congestion. It is true that many of these treaties come clustered in 'institutional packages like the *Law of the Sea* or are protocols nested under the same framework or convention[5]. It is also true that there are some benefits to such treaty congestion including increased visibility and awareness of environmental threats, the development of specific knowledge and centres of expertise, multiple treaties complementing and reinforcing eachother. That said, there is also a great deal of duplication and conflicting agendas and the linkages between many treaties could certainly be better addressed through the *clustering* of treaties. There has also 'been a tendency to assume that the autonomy of legal agreements implies autonomy of secretariats'. This has led to hundreds of geographically dispersed issue based secretariats each with institutional interests in further expansion of their work. Separate secretariats and negotiations while they allow many entry point for civil society, encourage competition, and some additional buy-in or engagement from the countries that host these secretariats, they also overwhelm negotiating calendars and in particular the budgets of developing countries. Many of the proposals for global environmental reform pose the elimination of inefficiencies created by this treaty and institutional proliferation through synergies or Super Cops.[6] It is difficult to prescribe a type of clustering, synergy development or institutional linkage as they all have their benefits and costs. It is clear there is a strong need to better link these institutions[7].

While there are a number of advantages to addressing environmental issues on an individual basis, and the existing systems of individual treaties provides a solid foundation for future global environmental governance, there is a need for increasing linkages between disparate environmental treaties and between environmental, economic, and political treaties. Complex adaptive management systems recognize these interconnections and also recognize environment as well as socio-political systems as more than a sum of their parts. In essence the scientific study of individual parts can not forecast with certainly the evolution of such systems under given circumstances because such systems are non-linear, characterized by positive and negative feedbacks and elements of surprise. This recognition of inherent uncertainty, is also a recognition that it is impossible to design a perfect solution. In this sense policies and institutional structures are experiments and we must seek to *learn from them*.

<u>How would a complex adaptive ontology impact the organization, authority and knowledge within systems of global environmental governance?</u>

Social Organization: Stand-alone, Centralized, Hierarchical and Integrated Decentralized and Distributed

[5] IISD (2006) Global Environmental Governance: A Reform Agenda. Pg 30
[6] (Carruthers, 2006)
[7] ' ' p 33

From the outset the system of global environmental governance has attempted to be both centralized and decentralized. Negotiations mandated the formation of a central coordinating body – UNEP and simultaneously encouraging the development of national, regional and local environmental organizations and a robust civil society. That said, there have been major flaws in such an approach. UNEP was more a symbolic gesture to a centralized, hierarchical system than a practical central coordinating agency because it lacked teeth. Furthermore, decentralization only went so far as NGO's (national and international) as well as local and regional organizations have been inadequately incorporated into the system of global environmental governance and finally despite increasing efforts to link environment and development, environment has largely been treated as a stand-alone issue in the global sphere.

There are many who recognize the lack of true centralized, hierarchical power in global environmental governance. There have been proposals to create some type of stronger environmental body, such as a World Environment Organization (WEO) within the United Nations, a revision of the mandate of UNEP to become a full environmental body, and/or a trusteeship council of the United Nations with a revised environmental mandate[8]. Although Juma[9] has argued that the creation of WEO is counter-intuitive to global decentralization trends it must be recognized that such bodies may help balance the playing field and give the environmental lobby more power to encourage integration of environment into trade, development, rights and security agendas. Such a high level forum might also provide the critical strategic coordination needed to cope with the growing complexity of the architecture of international environmental governance. Yet, if such reforms are to be undertaken they must simultaneously be undertaken with efforts to decentralize and to promote cooperation and coordination among international organizations and also between local, regional, national and international organizations.

It has, however, been well argued by Lee, Holling, Homer-Dixon and numerous other theorist of adaptive management that stand-alone centralized hierarchical, systems are less adaptive, less resilient and less capable of addressing complex problems. Furthermore, many of these reform proposals may inadvertently isolate environmental issues resulting in less rather than more integration. Newell points out that recent interest, within the WTO, in a WEO is driven by the desire of trade officials to remove complex environmental problems from their mandate.[10] This might result in the undermining of existing and growing linkages between trade policy and the environment; such as efforts to liberalize trade in goods that help achieve environmental sustainability. The challenge for advocates of global environmental reform is to ensure that reforms do not become a means to 'stovepipe' environment issues within a single agency; and

[8] (Strong, 2006)
[9] (2000)
[10] (2000)

thereby provide a means by which the WTO, other UN agencies, and the OECD can remove environmental considerations from their own agendas.

The need for integration is clear: National and international environmental policy, whether beneficial or detrimental, has frequently been an unintended consequence of conventional politics and policies.[11] The reduction of sulphur emissions in Britain in the late 1980s was the inadvertent result of Margaret Thatcher's attempt to undermine the power of trade unions and the associated decline in the coal industry.[12] Chemical-intensive agriculture and dense populations of livestock in Japan and Europe with associated environmental impacts can be at least partly attributed to farm subsidies.[13] Overgrazing and desertification in Central Asia can be attributed, at least in part, to Soviet and Chinese policies that reduced the mobility of Central Asian nomads.[14] China's collectivization policies and the Cultural Revolution in the 1960s, destroyed village-level constraints on marriage and fertility, thereby provoking a significant baby boom with consequent over-population.[15] This trend is likely to continue as trade agreements continue to push economic growth; and may have significant impacts on the nature and hence environmental impacts of this growth.

Likewise, environmental policies have often had affects on broader policy arenas.[16] Science has linked emissions from energy production and use to acid rain, smog, climate change and mercury in the environment[17]. Agricultural policies and methods may have impacts on nutritional levels and the ability of communities to endure various health challenges. Oil and point-source natural resource development may significantly affect all of environmental welfare, economic growth and political stability. It has also been argued that some measures to improve the environment, such as limiting greenhouse gas emission, may slow economic growth

These observations are by no means revolutionary but they underscore the need for integration. They suggest that despite all of our concentrated efforts at predicting and responding to environmental threats, and predicting potential emerging environmental impacts in all sectors, that often environmental policy making and the impacts of environmental policy making are unanticipated. In essence, the processes through which human activities produce their ultimate consequences transcend the traditional boundaries of nations, of sectors and disciplines. Emissions of greenhouse gases, whatever their source, contribute to changes in climate which affect everyone. Decisions taken to deal with economic and financial issues or to promote economic growth are the principal

[11] (McNeil, 2000, p 354)
[12] (McNeil, 2000, p 354)
[13] (OECD, 1998)
[14] (Humphrey and Sneath, 1996, Vol 1)
[15] (Lee and Feng, 1999)
[16] (Neuman, 1996)
[17] Environment Canada, (2003) Meterological Service of Canada Research and Development Strategic Program 2003-2012. p. 35.

determinants of environmental and social conditions at the local, national and global level and can also impact on peace and security. The collapse of the Asian Tigers in the 1990's which rapidly developed into a crisis threatening the entire global economy, dramatically brought home to us that the benefits of globalization are accompanied by a new generation of perils and it made clear that no individual nation, however powerful, can insulate its people against these risks or manage them alone. Neither can any of the main issues that affect the quality of life and sustainability of the human community, - access to food and water, managing the pressures for migration, protecting the environment, meeting social needs, ensuring employment and livelihoods, and, of course, maintaining peace and security – be managed in isolation. There is therefore a need for an inclusive and systemic governance structure to address these issues.

There has, of course, been progress in integrating environmental consideration into a broad range of agencies. There has been a gradual evolution of environmental regulation from the narrow consideration of ecosystem integrity to the broader consideration of sustainability that incorporates broad economic, social and environmental welfare.

The concept of environmental sustainability has been embraced by local, national and international environmental institutions and treaties. In 1987, the World Commission for Environment and Development (WCED), released a report, *Our Common Future*, which made the case for sustainable development – 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' – as the only viable pathway to a secure and sustainable future for the human community.[18] The UN Conference on Environment and Development (UNCED), a recommended outcome of *Our Common Future*,[19] was held in Rio de Janeiro in 1992.

Despite this new sustainable development agenda, environmental issues are still largely addressed separately from agreements on human rights, trade, and security. There is limited inclusion of environmental issues in other global forums such as the UN Security Council, the WTO, and the OECD. This is, of course, not to suggest that there is no integration; certainly, there has been discussion of the liberalization of environmental goods at the WTO. Further, NAFTA underwent an SEA; on occasion environment and security issues have been addressed at the UN (eg most recently climate change) ; and there is a growing movement within both the WHO and the IDRC to look at ecosystem approaches to human health, and at continuing research on scarcity and security. Nevertheless, environmental agreements still address human right, trade and development concerns inadequately; and agreements specifically on these other issues likewise neglect the environment.

[18] (Strong, 2000)
[19] (WCED, 1987, p310)

My voice clearly joins a chorus of voices calling for such integration. Far greater experts than I have proposed better integration of environment into human rights;[20] and Security Agendas.[21] Less attention has been paid to the value of cross-cutting and upstream tools, such as Strategic Environmental Assessments and Sustainability Appraisals which may be critical in ensuring integration of environmental considerations into security, trade and a broad range of public policies. The system of global environmental governance could benefit from greater development of these tools for integration.

Competence Knowledge: High technocratic, explicit vs. experiential, tacit

In his 1959 essay *The Two Cultures*, English novelist and scientist C.P. Snow argued that "the intellectual life of the whole of modern western society is increasingly being split into two polar groups" – science and art. The gulf between technical/analytical thinking and creative/humanistic thinking has become so fundamentally distinct that "those in the two cultures can't talk to each other". Snow argues that "when those two senses have grown apart, then no society is going to be able to think with wisdom". Current systems of global environmental governance may be lacking such wisdom.

Historically science and economics have been the language of environmental management. Scientists have calculated maximum sustainable harvests, catches, sustainable levels of toxic emissions in water, air and land. In light of this, environmental policies are always couched in the ostensibly neutral language of science and economics. Yet, conventional mechanistic science and economics may not be able to account for uncertainty which is particularly apparent in emerging environmental challenges such as climate change and biotechnology; which often require understanding of increasingly complex science and growing recognition of uncertainty.[22]

Such complex and adaptability mandates both the evolution of science and the incorporation of other forms of knowledge.

Within the system of global environmental governance there are multiple scientific bodies, each looking at a small piece of the environmental puzzle. Among these there is some great science - for example, the work of the International Panel on Climate Change (IPCC) is very well respected. There are, however, few scientific efforts to look at the larger picture of interconnections. To some extent the Millennium Ecosystem Assessment achieved this[23] and was largely applauded but there is now a need to ensure regular, far reaching, broad assessments and to build connections between existing scientific bodies.

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[20] (Couzens, 2005)
[21] (Schlingemann, 2005)
[22] (Berkhout et al, 2003. 10; McNeil, 2001)
[23] (IISD, 2006) 43, 44

The UNEP Governing Council as part of the Cartagena process for reform recently established a "Science Initiative" to strengthen UNEP's ability to monitor and assess global environmental change. This includes a proposal to create an Environmental Watch System as an integrated structure for scientific discussion underpinning international environmental governance. There is also a proposal to create an Intergovernmental Panel on Environmental Change to give scientific and technical advice to UNEP's Governing Council and the Global Ministerial Environmental Forum. Actions to create greater capacity for scientific assessment in developing countries are also articulated in the Bali Strategic Plan for Technology Support and Capacity Building.[24] These activities and the high-level recognition of the importance of strengthening environmental monitoring and linkages between science and policy making are positive trends underlying which is the belief that global environmental governance needs to be grounded in authorative science and knowledge.

To a certain extent growing linkages between existing narrowly focused scientific bodies will address the growing understanding of the interconnection between environmental systems, there are however additional consideration in light on non-linear systems, surprise and uncertainty.

Historically, science on which environmental management has been based has assumed that ecological systems are relatively stable equilibrium systems. There is growing understanding of the fact that ecological systems are non-linear. The Dust Bowls in the US,[25] the extinction of certain species and the growing inability to control forest fires in various parts of the world[26] are testaments to the fact that certain types of science based management to maintain stable systems may be counter-productive as they create dependency on increasingly greater and increasingly inefficient control measures.[27] Since the early 1990s, there has been a shift from environmental management of equilibrium systems to growing recognition of non-linearity and complexity;[28] and therefore of the need for flexible, adaptive and responsive institutions with which to assess and respond to environmental challenges.[29] In part, science needs to evolve in order to provide useful information in the context of complex, adaptive, non-linear systems characterized by surprise. This will require integrated monitoring as well as the assessment and management of cumulative risks and resilience. In essence there is a need for improved long range forecasting with alternatives, non-linearity's and surprises incorporated into models. It is also essential for science to step back and look at the big picture not just the individual problems.

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[24] IISD (2006, 43)
[25] (Worester, 1985, 221)
[26] (Worester, 1997, 128)
[27] (Worester, 1997)
[28] (Holling, 1986; Zimmeter, 1994; Kay, 2000. 123)
[29] (Berkhout et al, 2003. 12)

In addition to this, other forms of knowledge, knowledge Snow would categorize as “art” – history, social science, community based and traditional knowledge becomes critical both in order to gather a wealth of present and historical information and to promote dialogue as policy makers face difficult decisions between various trade-offs.

There has been a growing understanding of the importance of cultural and social information. Environmental issues have been understood to be the products of cultural and political discourse. For example, Escobar has argued that, while biodiversity has concrete biophysical referents, specific narratives about biodiversity and associated policy options are the product of specific narratives of powerful actors.[30] Authors such as Peet and Pratt,[31] and Berhout, Scoones and Leech,[32] have argued that struggles over resources are essentially struggles over power. Popular narratives about the environment have historically had their origins in the religious, political and economic institutions of the powerful, with their capacity to persuade and coerce; and alternative narratives, embedded in hunter-gatherer societies, social movements, trade unions or civil society, have been ignored, misinterpreted or romanticized.[33]

This is not to say that Western science is not important. Scientific knowledge is critical to enhance understanding of complex natural and ecological systems but it can be mis-used, it can be a tool wielded by the powerful to re-enforce their own narratives and interest, and/or a tool blindly used without foresight to implement policies that may work in the short-term but that in the long-term may be detrimental. Despite progress, there is a history of failed scientific management that has led, for example, to fisheries collapses, unnecessary and mismanaged forest fires, and the displacement of people. The challenge is again to *learn from our mistakes.* This means embracing all types of knowledge. . Local and indigenous knowledge is a safe-guard against the misuse of such scientific insight and is increasingly understood to provide valuable insights into environmental and social phenomena. In some instances this has been viewed as a challenge to science- and economic-centric epistemology that was a prominent aspect of the flawed historic belief in stable equilibrium systems with finite limits that could be identified by science and avoided by scientific management.

Source of Legitimacy Power: State centric, policy communities, management elites, reinforced by law and incorporation of civil society, democratic actions, voluntary initiatives, markets

[30] (1998)
[31] (2004)
[32] (2003)
[33] (Berhout, 2003)
[3] It is based on the Stockholm Declaration that declares that ‘Man is both creature and moulder of his environment ’.

International architecture was once largely based on notions of the supreme power and authority of states. As such, in systems of global environmental governance, state-centric institutions have been created to allow ostensibly equal sovereign entities to come together to make decisions to protect common property. The Conceptual Framework for the Stockholm conference drafted in May of 1971 is particularly revealing.[34] The first general theme on which the framework was based states "Governments, either individually or collectively, are the only bodies with the authority to act or to authorize action to identify, relieve or solve environmental problems" (2).

While projects and programs ultimately happen at the local or national level, it is essential that there is agreement at the global level on those policies and measures which are essential to both avoiding major risks to the survival and well being of the human community and to identify those opportunities to simultaneously contribute to the economic welfare of humanity and the environmental welfare of the planet. States may be the only entities with the power to carry out such global negotiations and state based treaties such as the Conventions on Climate Change, Biodiversity and Desertification are valuable and provide both a framework for cooperative action to achieve poverty alleviation and sustainable development and a means to link local, national and global action.

That said, it has been extensively argued that states and state governments are not the only entities that should have voices in systems of global governance and that state-centric treaties, while perhaps a necessary part of global environmental governance are not sufficient to incorporate the range of actors essential to the implementation of truly sustainable solutions[35].

The question is which players need to be better incorporated into systems of global environmental governance and what tools and techniques can be further developed to incorporate them.

Globalization has resulted in new forms of cooperation and competition, the devolution of power from States downwards to local grassroots organization and upwards to multinational entities among these emerging powerful multinational corporations (MNCs) are becoming globally integrated enterprises. Simultaneous forces of globalization and grass-roots mobilization has resulted in a shift away from state-centred institutions. This shift appears to be toward the incorporation of a broad range of local, regional, sub-national, national and international actors; and a growing understanding of the need to link local, regional, national and

[34] United Nations (1971). Draft: The Conceptual Framework for The 1972 Conference on the Human Environment. May 10th, 1971. (pg 2) http://www.unlibrary-n0061irobi.org/PDFs/Con_framework.pdf
[35] See for example (Mukul, 2006)

international governance forums, to reflect the growing understanding of the porosity of states and the increasing range of fora in which individuals can act.[36]

In addition to this, traditionally more marginalized countries such as China and India are increasingly important actors in multiple arenas of global and regional governance and are increasingly becoming more so. China, India and many MNCs are also among the world's worst polluters. The rapidly expanding economies of China and India are showing a swift increase in CO_2 emissions. China, which is already the second largest polluter, increased its emissions by 33 percent between 1992 and 2002; while India's emissions grew 57 percent in the same period. Likewise, MNCs, despite some initiatives promoting green merchandizing and corporate social responsibility, remain responsible for large shares of global environmental damage.

This presents new challenges for state-centric systems of environmental governance that do not engage MNCs and treaties that incorporate equal but differentiated responsibilities such as the Kyoto Protocol that do not effectively engage state's such as China and India. This may demand a shift from state-centric to multilevel governance systems and for greater cooperation between nations such as China and India and the traditional power-holders.

This is not to say that States are not important. Governments play a critical role in protecting citizens from influences over which they have no control, and by reducing or eliminating factors/stressors which can be controlled. They discharge this role monitoring and watching (to define and understand the risk, long term predictions, impacts assessment), warning and informing (to help citizens take action to protect themselves, their property and their business) and by regulating and intervening (where volunteer measures aren't enough, to develop wide standards for safety, to prepare society for change. In this context, their participation will always be central to global environmental governance.

In the context of global environmental systems while states will inevitably remain the key actors and treaty makers, the integration of other, increasingly powerful local and global players is important as is the shifting power dynamic between states.

The increasing importance of actors at the local and multinational level suggests that state-centric treaties can not be the centre piece of future governance regimes. While such treaties are important it has been suggested that emerging forms of transnational law may be increasingly critical in environmental regulation. In addition to global treaties there js a need to develop a legal regime, or to strengthen the existing legal regime, by which people in one country may litigate against a neighbour for global environmental harm.[37] Such legal recourse would be a valuable means for linking the local and the global and

[36] (Roseanau, 1992;Vogler and Jordan, 2003)
[37] (2006)

would serve to provide regular testing and challenging of a system to create renewal and innovation with the system rather than collapse predicted in Hollings theories of panarchy.

There are also a number of other tools to engage non-state actors. Over the last few years there has been increasing use of voluntary initiatives and market based mechanism. It can be argued that the system would benefit from great use of these mechanisms.

Slow progress is being made in the incorporation of these actors. China has been involved in international environmental policy-making since the Stockholm conference in which China participated after taking over the China seat in the United Nations. The creation of the National Environmental Agency in China, signified the increasing importance of environmentalism in China. Their growing interest in green GDP and sustainable energy (despite their 30 + nuclear power stations and the coal-fired power stations) may offer some hope of Chinese leadership in these areas. Their efforts at creating sustainable urban housing, particularly in their recent pilot cities near Shanghai, also offer hope for environmental innovation and leadership. Moreover, China's critical role in the Montreal agreement suggest a growing potential influence in global environmental policy. Nevertheless, a great deal still needs to be achieved to ensure reasonable management and exploitation of watercourses, natural resources and environmental services. (Strong, 2006).

The question is how to engage these players in new ways not just through treaty processes but through market based mechanisms, voluntary initiatives and service provision There also need to be greater efforts to integrate these players in conventional, treaty based management systems. In the current environmental governance framework neither China nor India plays a dominant role in hosting UN agencies or regime bodies; and there has been relative acceptance of the limited responsibilities of developing countries in implementing certain measures. Of particular importance, China and India were exempt from reducing greenhouse gas emissions reductions under the Kyoto Protocol. As China and India produce an increasing percentage of global greenhouse gas emissions; important questions about their role in international environmental architecture may need to be reconsidered.

The private sector has a critical influence on global environmental governance. This sector will never have a vested interest in negotiating strong mandatory legislation against pollution unless there is a market for the elimination of pollution such as carbon trading or technology which makes such activity affordable and beneficial. The primary mandate of the private sector is its own viability based on the integrity of systems, economic principals and risk management but they also have obligations to and vested interests in being good

corporate citizens by giving something back to the local community by providing public services, and minimizing damage to environment and society. That said, international treaties and protocols can stimulate innovation and right action by providing public interest and financial incentives for right action.

Talk of regulating the polluting activities of multinational corporations (MNCs), who, according to the International Chamber of Commerce's own estimates, are responsible for a large percentage of global emissions, have met with resistance. There have however, been a number of voluntary initiatives which offer promise. There are the OECD Guidelines for MNCs, the UN Global Compact, and voluntary associations such as the World Council on Sustainable Development. Yet, on the whole, there is little cooperation and coordination between these systems and existing multilateral institutions which are state-centric based on treaty systems that exclude corporations and local players. In essence, to date, the international system has failed to find viable solutions to corporation's power and in many cases the poor environmental record of corporations. Powerful industrial lobbies, increasingly globally organized, have expended vast financial and political resources in ensuring that outcomes at the international level have not gone further, and that their core activities remain unaffected by the specter of global regulation particularly in the context of the climate change regime. Reforms of institutional infrastructure must somehow address this imbalance.

There has also been recognition of the growing divide between the 'haves' and the 'have-nots'; not only between nations but within nations. This illustrates a need to move beyond the North/South divide. While the creation of Super Cops, or of a World Environment Organization, may reduce the number of meetings and therefore the resources required for developing country participation; Gupta points out that the North may become even stronger if it can concentrate its power in one body. This is not a call for the elimination of common but differentiated responsibilities between nations; as such efforts are critical to social justice. It is, rather, a call to try to shift ingrained negotiating blocks, such as the G77 and the G8, by establishing social justice criteria and flexible categories in which players are mobile rather than placed in largely inflexible North–South groupings; such as under the labels of Annex I and non-Annex I which are the basis for the flexibility mechanisms under the UNFCCC. Flexible categories may encourage countries, which are already considering deviating from the positions of their blocks, to engage more constructively in the negotiations; and would serve to foster trust, understanding, and constructive communication.

There have been significant efforts to compliment conventional systems of global environmental governance with more decentralized, market based and voluntary initiatives and a range of stakeholders. As Kakakhel points out, 'UNEP has made unprecedented and unrivalled progress in encouraging regional and sub-regional co-operation, as well as enlisting the participation of NGOs and Civil

Society in the deliberations of Governing Council/Global Ministers Forum'.[38] Likewise, there has been active engagement by such groups in the International Environmental Governance Processes; and the United Nations Development Group. The World Summit on Sustainable Development held in Johannesburg, South Africa, in August 2002 stimulated the announcement of more than 200 partnerships and initiatives involving not only governments, but also citizen groups and businesses for implementing commitments at the domestic level. Yet, the connection between such initiatives and global treaties remain inadequate and there are **'**significant and on occasion apparently insurmountable problems in translating international agreements into sustainable solutions that can be implemented on the ground'.[39]

In essence systems of global environmental governance are and will remain largely state centric based on input from policy communities and management elites and reinforced by law. After all, bureaucracies do not die. That said there needs to be more explicit incorporation of local and regional actors, civil society, democratic actions, voluntary initiatives and markets This suggest a need for multilevel governance with municipalities, citizens, NGO's, civil society organizations and various levels of government playing an increasingly important and increasingly recognized role in not only implementing solutions on the ground but in influencing global treaties.

Goal: Immediate or Short-Term Optimization of expected utility according to explicit, well-defined preferences and satisfaction of multiple often conflicting and sometimes incommensurable values

Policy-makers respond more readily to clear and present dangers and opportunities than to more subtle and gradual worries about the environment[40]. In light of this the goals of multilateral environmental treaties have often been short term and narrowly defined. Short term goals and objectives are critical to maintaining momentum yet they must be informed by long-term goals and open dialogue regarding conflicting values.

Leadership:

Mitchell[41] argues that the real problem with the current approach to international environmental regulation is not the lack of institutional capacity, but an absence of will to address environmental issues. Newell[42] argues that traditional debates surrounding the reform of global environmental institutions ignore the more critical barrier to effective environmental governance, namely political will. This is a point worth emphasizing. We need dozens of Maurice Strong's. The question is where such innovative cutting edge leadership will come from and whether in

[38] (2005)
[39] (Vogler and Jordan, 2003. 141)
[40] McNeil, 2000. p 355)
[41] (1999)
[42] (2000)

fact high profile figures like Al Gore can become advocates for strengthen systems of global environmental governance.

Conclusion

International environmental institutions of the 1970s were based on certain geo-political realities; and embraced specific narratives about human/environment relationships. Despite some progress, the current system of global environmental governance, largely views the environment as a compilation of its parts. Issues are addressed in isolation, and new treaties largely based on technical science are developed and signed between states and implemented in a top down manner. Yet, *the* top does not have and has never had the teeth to actually enforce implementation.

Global environmental governance is still largely issue-based rather than fundamentally interconnected. Even in addressing relatively broad ranging environmental issues such as climate change, there are only limited efforts to address linked environmental issues such as biotechnology. In a truly effective system such issues would be addressed simultaneously in coherent and reinforcing ways. “Climate change and variability impact on land use, ecosystem health and water supply. Changes in land use affects community planning, migration routes, habitat availability and water quality. Our changing environment affects the spread of animal diseases, some of which affect humans. The six original environmental issues have created an intricate web of interrelated issues. In addition, there are local, regional and global aspects to these environmental issues.

Many of the most significant actors at the local and global levels are excluded from these binding treaties and there is therefore a great deal of difficulty in translating these agreements into meaningful action on the ground. Additional treaties and associated layers of bureaucracy make this system increasingly cumbersome and complex, and less adaptable and so it is widely viewed as inadequate to the growing needs that are associated with it and widely unable to have foresight, and resiliency in the face of new trends.[43]

Clearly we need a collaborative, integrative approach to global environmental governance in order to ensure that solutions are multi-scale and multidisciplinary and can be applied multilaterally.”

There is, however, a risk that the cure will be worse than the disease. Najam[44] states that global environmental reform or ‘institutional tinkering’ is neither necessary nor sufficient to improve sustainable development; and may even ‘make things worse by further burdening an already over-burdened system’.[45]

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[43] (Moltke, 2005. 175)
[44] (2005)
[45] (236)

The challenge is to understand the weaknesses of the current system and to ensure that any reform efforts strengthen rather than weaken the existing system.

This paper did not provide answers. It did seek to unpack the various elements of this system of global environmental governance including its defining ontology, its institutional organization, its sources of knowledge, legitimacy and power, and its objectives. It has argued that distributed social networks are essential for complex adaptive management as they are forums for discourse in which countless agents are able to anticipate, predict and propose solutions to potential challenges. And such networks will benefit from conventional management and be able to apply the narratives of problems and solutions offered by science and economics to rigorous debate and analysis. If open to such networks, our technocratic, top-down systems of global environmental governance may better learn what approaches to a particular problem have the highest likelihood of succeeding if they incorporate—and perhaps co-evolve with other networks. In addition to embracing distributed social networks, conventional technocratic system of global governance must also be strengthen to have the legal authority, and political power to fulfill its mandate and must embrace cutting edge integrated science that takes account of non-linearity and surprise. This is essential embracing the two management approaches – a hybrid between a convention centralized, top down system and a more flexible, disperses complex adaptive system. Perhaps most importantly, leadership is needed to implement the reforms necessary to ensure that we have an effective system of global environmental governance with both teeth and flexibility.

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