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Internationally agreed environmental goals: A critical evaluation of progress

Jason Jabbour [a,*], Fatoumata Keita-Ouane [a], Carol Hunsberger [b], Roberto Sánchez-Rodríguez [c], Peter Gilruth [a], Neeyati Patel [a], Ashbindu Singh [e], Marc A. Levy [d], Stefan Schwarzer [f]

[a] United Nations Environment Programme, Scientific Assessment, 30552 Nairobi, Kenya
[b] International Institute of Social Studies, PO Box 29776, 2502 LT, The Hague, The Netherlands
[c] El Colegio de la Frontera Norte, San Antonio del Mar, 22560, Mexico
[d] Center for International Earth Science Information Network, Earth Institute, Columbia University, Palisades, NY 10964, USA
[e] United Nations Environment Programme, Regional Office for North America, Washington, DC 20006, USA
[f] United Nations Environment Programme/GRID-Geneva and University of Geneva, Switzerland

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ABSTRACT

The number of international environmental institutions, goals and agreements has increased greatly since the United Nations Conference on the Human Environment in 1972. However, the results of this proliferation for environmental protection have been mixed. The upcoming "Rio +20" conference (2012), offers world leaders an opportunity to reaffirm the importance of achieving a sustainability agenda and to revisit their strategies for doing so. To inform this process it is crucial to learn from the ambitions, achievements and shortcomings on goal attainment to date. Drawing on the United Nations Environment Programme's fifth Global Environment Outlook report (GEO-5), this paper presents an evaluation of progress made on globally agreed environmental goals in relation to a series of biophysical trends. The analysis suggests a picture of patchy achievements rather than sustained progress. The most encouraging results have occurred where measurable targets were established on problems with relatively straightforward causes and courses of action. Key obstacles to the achievement of goals include a series of mismatches: between narrow objectives and the need for integrated approaches; between types of problems and types of solutions; between the fragmentation of governance and the need for collective action; between science and policy; between the responsibilities and resources of environmental institutions; and between complex

* Corresponding author. Tel.: +254 710682332.
E-mail addresses: jason.jabbour@gmail.com, jason.jabbour@unep.org (J. Jabbour).

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systems and the desire for measurable outcomes. Overcoming these obstacles will require not only learning from past successes and failures but also adapting this knowledge to environmental, political and economic circumstances that have changed considerably over the past 40 years.

1. Introduction

Since the 1972 United Nations Conference on the Human Environment in Stockholm there has been a growing recognition of the importance of multilateral cooperation in addressing environmental issues, resulting in an ever-increasing number of environmental institutions, goals, and agreements. Despite this, environmental conditions have continued to degrade at an alarming pace, exacerbating existing vulnerability, poverty, and food insecurity (UNEP, 2012a, 2012b; UNEP, 2011a, 2011b; UNEP, 2007; Butchart et al., 2010; IPCC, 2007; MA, 2005). Taken as a whole, the magnitude, extent, and rate of change of environmental conditions are without precedent during human history (Zalasiewicz et al., 2011). Earth systems are being pushed toward their biophysical limits; strong signals suggest these limits are close, and have in some cases been exceeded (Lenton et al., 2008; Fabry et al., 2008; Rockström et al., 2009; Smith et al., 2009).

In June 2012, state, market, and civil society leaders will gather in Rio de Janeiro for the second Earth Summit, dubbed "Rio+20". The aim is to renew political commitments, assess progress made since the first Earth Summit of 1992, and reflect on real and tangible challenges that continue to obstruct the achievement of sustainability objectives at local through global scales. The Rio+20 conference will provide an opportunity to take a critical look at environmental institutions and policies in the 21st century. The difficult question facing the international community is why, in aggregate, the goals agreed through the policies and principles put in place over the past 40 years have not been met.

Through the process of producing its fifth Global Environment Outlook report (GEO-5), the UN Environment Programme (UNEP) has recently undertaken a collaborative assessment of progress in relation to a broad range of internationally agreed environmental goals. This paper draws on the findings of GEO-5 as well as recent environmental governance literature. It seeks to identify lessons learned from comparing the goal-setting efforts of the past several decades with actual environmental performance over the same period.

We begin with an historical overview of the establishment of international environmental institutions, goals and agreements. The second part presents analysis from GEO-5, using biophysical trends in the domains of atmosphere, land, water, biodiversity, chemicals and waste to critically evaluate progress towards – and gaps in – goal achievement. The third part discusses challenges and constraints that inhibit goal attainment. The article concludes by offering suggestions to Rio+20 participants and others regarding areas where opportunities exist to enhance enabling factors.

2. International environmental goals: a brief history

The first global conference on the environment, held in Stockholm in 1972, set in motion four decades of intensive debate and multilateral negotiations on environmental policy. This historic gathering, the United Nations Conference on the Human Environment, raised awareness of an issue hitherto little talked about – the 'global environment' – thus securing a lasting, albeit often precarious, place for the environment on the international governance agenda.

Twenty years after Stockholm, as a result of vastly improved knowledge about the state of the environment and the extent to which environmental conditions were deteriorating – a reality much worse than previously understood – world leaders gathered in Rio de Janeiro at the 1992 UN Conference on Environment and Development (UNCED), also known as the Earth Summit. Flush with the hopes of investing the post-Cold War 'Peace Dividend', UNCED delegates discussed how to

combine the imperative of economic development for the world's poor with protection of the environment to ensure a sustainable future.

The 1987 Brundtland Commission report *Our Common Future* (Brundtland, 1987), which paved the way to Rio, was widely attributed with popularizing the term 'sustainable development' (Langhelle, 1999), first articulated as "*development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*". Over the years, the discourse of sustainable development has given rise to considerable debate over its many interpretations, influences, transformations, and shortcomings (Zaccai, 2012). Despite inherent and persistent definitional ambiguities, at a basic level, the notion of sustainable development continues to be the acknowledged goal for many policy domains, including the environment.

The outcomes of the 1992 Earth Summit were the Rio Declaration and Agenda 21, important steps towards sustainable development. The former included 27 principles that nations committed to and the latter articulated a comprehensive plan of action for the achievement of sustainable development in the 21st century. It covered socio-economic and environmental issues, and suggested roles for a wide variety of stakeholders – engaging actors beyond the state and across scales – including international non-governmental organizations, communities, local government and civil society organizations (Andonova and Hoffmann, 2012).

Further dimensions of environmental goals emerged through the negotiating agenda of the General Agreement on Tariffs and Trade (GATT), at first with the concern that environmental legislation could be interpreted as a non-tariff trade barrier and thereby impute the environment as a last refuge of protectionism (Hoekman and Kostecki, 1995; Jackson, 1997). But in the lead-up to the 1992 Rio Earth Summit, serious consideration was undertaken of international trade's potential contribution to addressing environmental problems. In 1994, the GATT parties established a Committee of Trade and Environment that was tasked to examine interactions between trade measures and environmental measures in order to promote sustainable development. The result was a series of recommended reforms to the provisions of the multilateral trading system, feeding eventually into the GATT's metamorphosis to the World Trade Organization in 1995 (WTO, 2011; Demaret, 1995). These deliberations also foreshadowed an important discourse about trade policies as a means of enforcing environmental regulations (Xing and Kolstad, 1996).

In September 2000, leaders from 193 countries agreed to the Millennium Development Goals (MDGs). These represented another important addition to the existing set of sustainability goals and targets. The MDGs aim for a future with less poverty, hunger, and disease; greater survival prospects for mothers and their infants; better educated children; equal opportunities for women; a healthier environment; and a world in which developed and developing countries work in partnership for the betterment of all (UN, 2000). The eight MDGs provide a framework of 21 time-bound targets by which progress can be assessed along with 60 indicators to measure and show progress by the year 2015. While environmental themes cut across several MDGs, they are most prominently highlighted in MDG-7: Ensuring Environmental Sustainability. MDG-7 is divided into four targets that emphasize sustainability principles: reversing natural resource degradation, reducing biodiversity loss, increasing access to safe drinking water and sanitation, and improving slums.

Environmental targets were also adopted in 2002 at the World Summit on Sustainable Development (WSSD) in Johannesburg (UN, 2002). With the Johannesburg Declaration on Sustainable Development, world leaders reaffirmed their commitment to advance the three pillars of sustainable development – environmental protection, social development and economic development – and further committed themselves to expedite the achievement of the time-bound targets contained within a new Plan of Implementation for the Johannesburg Declaration on Sustainable Development. Unlike Agenda 21, the Johannesburg outcome was intended to go beyond debate and catalyze a move to action and results by instituting targets and timetables; however, most of the goals and targets remained broad and in some cases virtually un-measurable.

2.1. The current landscape of environmental agreements

Since 1972, there has been a proliferation of environmental treaties and other agreements (global, regional and bilateral) designed to help achieve sustainable development (Fig. 1). The International

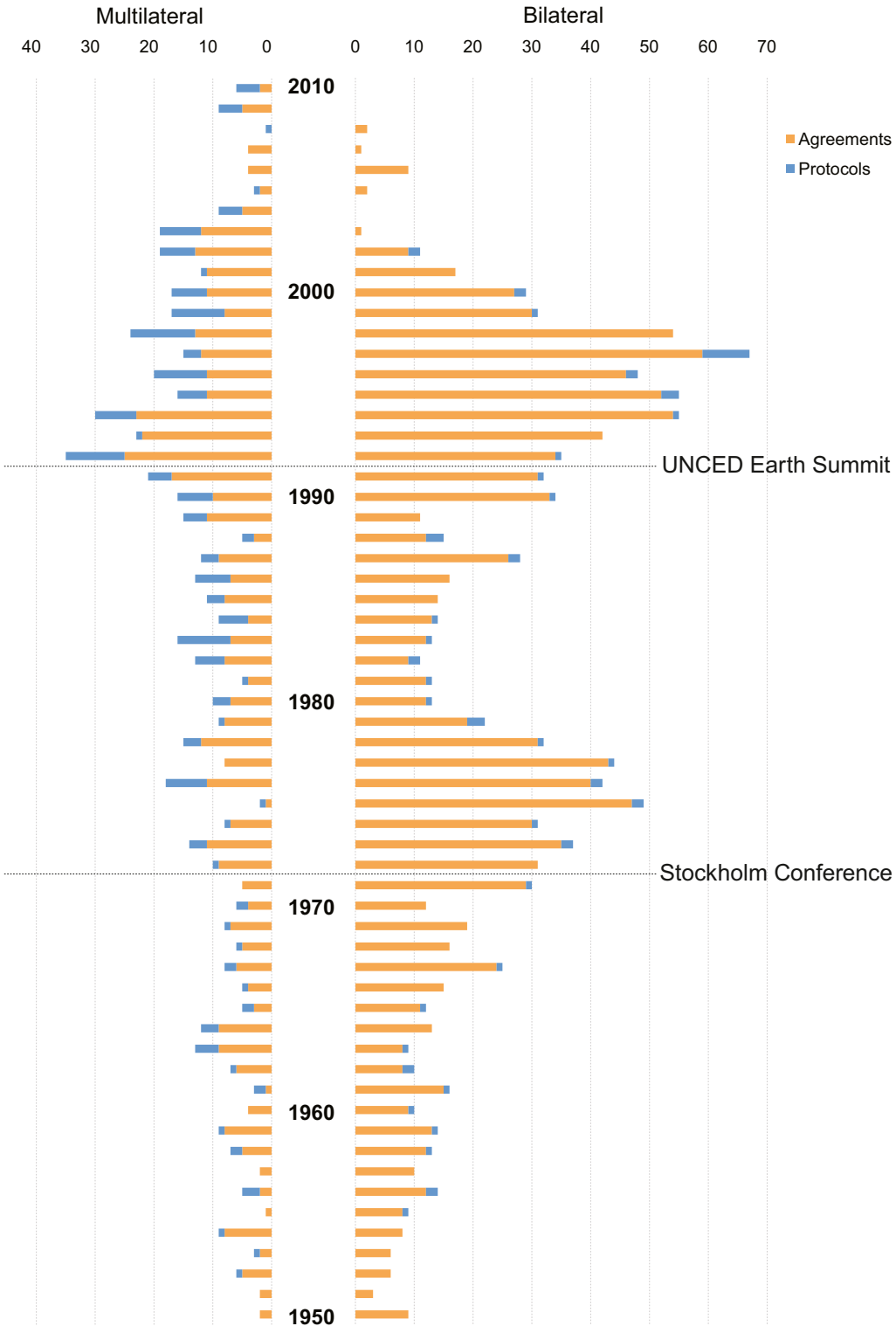

Fig. 1. International environmental agreements and protocols since 1950: environmental agreements are understood here as intergovernmental legally binding documents with a primary purpose of preventing or managing human impacts on natural resources.

Environmental Agreement (IEA) Database Project managed by the University of Oregon lists some 560 IEAs (Mitchell, 2012), of which 350 came into existence between 1972 and the early 2000s. The number of agreements becomes even higher when the protocols and amendments built around the main agreements are included. As of 2010, an inventory of IEAs approximates 60 related to

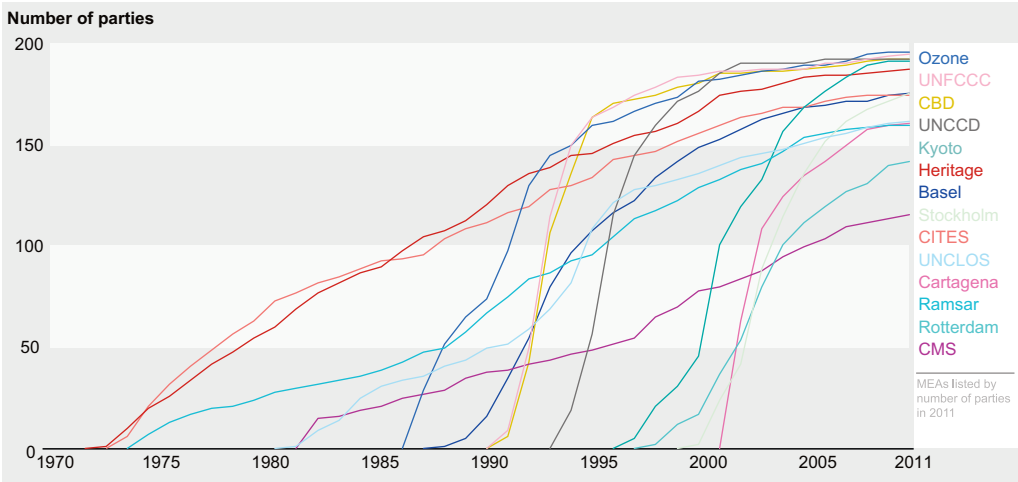

Fig. 2. Growth in ratification of environmental treaties, 1971–2011.

the atmosphere; 155 related to biodiversity; 180 addressing chemicals, hazardous substances, and waste; 45 related to land use; and another 195 that are broadly related to water resource issues (Knigge et al., 2005; Najam et al., 2006; Mitchell, 2012).

The United Nations has also registered more than 500 multilateral environment agreements (MEAs), in a programme called ECOLEX (ECOLEX, 2012). The core of the global environmental legal framework, however, is made up of a more limited number of treaties with a growing number of ratifications (Fig. 2). While the creation of the various environmental conventions and protocols can be viewed as an achievement, it also raises the need for continuing support in developing countries when national administrations become overloaded with reporting requirements and countless international meetings (Najam et al., 2006; Biermann, 2007). On one hand, the rapid growth of MEAs and establishment of other shared goals could be seen to signal a collective appreciation of the scope and severity of environmental issues (Roch and Perrez, 2005; Kanie, 2007; Oberthür and Stokke, 2011). On the other hand, despite – or perhaps because of – the proliferation in the number of environmental agreements, the political will required to ensure global environmental protection has been suboptimal. The resulting patchy achievement of goals and agreements is illustrated in the following section.

3. GEO-5 analysis of goals and gaps

Over the past 15 years, UNEP has published four flagship assessment reports – the Global Environment Outlook (GEO) series – as part of its mandate to keep the state and trends of the global environment under review. Using a consultative and collaborative process involving hundreds of scientific and policy experts, GEO aims to help bridge the gap between science and policy by translating the best available scientific knowledge into policy-relevant information for decision-makers. An important focus of GEO assessment reports has been on identifying and analyzing environmental problems and solutions through the DPSIR framework consisting of Drivers, Pressures, States, Impacts and Responses along a continuum (Stanners et al., 2007). One of GEO's strengths is its integrated assessment approach, which allows for a comprehensive, multidisciplinary overview across different environmental themes in the global and regional context.

The fifth edition in the GEO series, GEO-5, contains an additional element: the state and trends analysis is linked to a review of the progress made towards the achievement of selected key internationally agreed goals. Relevant goals and objectives were identified from a range of sources including legally binding instruments (i.e., international treaties, conventions, or protocols); and nonbinding instruments, including outcomes of United Nations summits and world conferences, and conferences convened under the auspices of specialized agencies. The outcome of the GEO-5 assessment is expected to provide a key input to the intergovernmental deliberations leading up to the UN conference on Sustainable Development in Rio de Janeiro in June 2012.

In this attempt to measure the state of the environment against the backdrop of internationally agreed goals, key indicators and time-series datasets were used, where available, to measure progress. GEO-5 collaborators and experts in each region first identified a subset of key regional priority themes for analyses (Table 1) through a series of surveys and expert-lead consultations. For each issue, a comprehensive inventory of existing internationally agreed goals, compiled by UNEP with the support of the Government of Switzerland, was then considered. The selection process was initiated in July 2010, with questionnaires being sent out to a wide range of key stakeholders in each region to gather preliminary information. Respondents were asked to identify priority environmental challenges in their respective regions, and the manner in which these challenges relate to regionally relevant international goals. With this information, regional consultations with various policy and environmental experts were held from September to October 2010. Each consultation resulted in a report that included key recommendations and target audiences, in addition to the selected priority themes and internationally agreed goals.

The international goals selected to guide the analysis in GEO-5 cover a broad spectrum of issues and vital targets related to food security, poverty reduction, vulnerability, ecosystem resilience, human well-being and environmental sustainability. For the purpose of this analysis, goals have been classified vis-à-vis their achievement in terms of: 'significant progress'; 'some progress'; 'very little to no progress'; and 'further deterioration'. Provisions are also made to report whether there is 'insufficient data to evaluate progress' or it is 'too soon to assess the goal'.

The analysis of environmental agreements conducted by GEO-5 authors revealed a number of difficulties in applying straight compare- and- contrast techniques. It also shed light on the complexity and limitations of such an investigation in the face of scarce data and limited monitoring and evaluation frameworks. The analysis found that it is exceedingly difficult to assess the progress of many goals due to lack of verifiable indicators, quantifiable targets, and reliable data-especially regarding biodiversity, chemicals and hazardous wastes, and several aspects of land use and conservation of terrestrial ecosystems. Reliable baselines, against which to measure progress, and robust monitoring systems that can collect data at regular intervals, need considerable improvement for many themes, and in some cases are absent.

The task of assessing progress in meeting internationally agreed goals is further complicated by the fact that most goals cannot be considered in isolation. Due to complex tensions and synergies among them, progress towards one goal must be viewed in light of implications to other goals. For example, the analysis of goals related to land highlights friction between MDG 1, on reducing hunger, and MDG 7 on ensuring environmental sustainability. Increasing food production through agricultural expansion

Table 1
GEO-5 Priority themes by region.

	Africa	Asia and the Pacific	Europe	Latin America & the Caribbean	North America	West Asia
Environmental governance						
Climate Change						
Energy						
Air pollution						
Land						
Freshwater						
Oceans and seas						
Biodiversity						
Chemicals and waste						

Selected as a theme

Selected as a cross-cutting theme

Regional consultations identified which themes were the highest priorities for each region. Some chose to highlight additional themes that cut across the priority themes.

directly compromises the protection of forests, wetlands, and other ecosystems providing services for human well-being that are less obvious than food, but no less important. Another example of such friction is found in targets for freshwater: dams may interfere with protection and restoration of ecosystems but they also may improve the availability of freshwater to communities. Thus, an integrated perspective on goal achievement is necessary but complex. With these caveats in mind, the following sections summarize GEO-5's assessment of progress toward internationally agreed goals related to the themes of atmosphere, land, water, biodiversity, and chemicals and waste. Table 2 provides an overview of the progress towards the goals for each of these themes.

3.1. Atmosphere

Atmospheric goals include those related to air pollution, climate change, and stratospheric ozone depletion. The GEO-5 analysis studied a total of nine internationally agreed atmospheric goals. Of those, two goals show significant progress, five show some progress, and two show very little or no progress. Differences in progress on the goals reflect variables such as the size of the economic sector targeted for change, type of behavioral shifts required by solutions, complexity of the issues, relative costs, and degree of concern.

The two goals demonstrating significant progress are the Montreal Protocol to the Vienna Convention to eliminate production of chlorofluorocarbons (CFCs) that destroy the stratospheric ozone layer, and the campaign to remove lead from automobile fuel, successful in all but six countries of the world. The Montreal Protocol has resulted in an almost 100% reduction in the consumption of CFCs globally. Removal of lead from gasoline reduces the damage to children's brains and central nervous systems at high exposures and to their immune, reproductive, and cardiovascular systems at lower exposures. A reduced level of lead in children's blood can be detected as a consequence of the change in petrol composition.

In contrast, the targets and goals set for climate change mitigation remain far from being achieved, and emissions continue to rise (Fig. 3). A small reduction in the rate of CO_2 emission increase in 2009, due to the global financial crisis, is overshadowed by the 2010 increase in emissions that rivaled the highest rates of the last decade. The 2010 rate of emissions from fossil fuel burning and cement production was the highest ever recorded and the atmospheric concentration of CO_2 at the end of 2010 was 398.6 ppm (parts per million), about 39% more than the 278 ppm in preindustrial 1750. The GEO-5 analysis considered this as very little to no progress.

The non-binding Copenhagen Accord of 2009-'noted' by 114 countries-recognized the need for emission targets that will hold the increase in global temperature below 2 °C-a concentration level of 450 ppm of carbon dioxide in the atmosphere. However, under the current levels of promised cuts, a gap of at least 5 GtCO2e will be left by 2020. Compared to concentrations that result in a 2 °C increase in global average temperature, this gap is equal to the total emissions of the world's cars, buses and trucks in 2005 (UNEP, 2010). This situation illustrates a problem that is becoming more apparent as negotiations to address environmental degradation bog down for years and even decades.

3.2. Land

Internationally agreed goals related to land issues include those relating to protecting temperate and tropical forests, preserving and restoring wetlands, combating desertification, valuing ecosystem services, and increasing agricultural productivity. Of the nine internationally agreed land goals examined in GEO-5, four show some progress, including MDG 1 to 'eradicate extreme poverty and hunger,' which is closely related to food production through agriculture. The number of undernourished people, while increasing overall, has decreased as a proportion of population. However, while food per capita is increasing, a large gap between regions remains. Goals related to soil fertility, rate of soil loss, land use and land cover change are not showing significant progress.

Overall, competing demands for land make conservation increasingly difficult, with deforestation rates still dangerously high (mostly in the tropics) despite a slight decrease or even forest regrowth in the northern hemisphere (Fig. 4). The GEO-5 analysis revealed the need to acknowledge the interactions between different components of social and ecological systems at different scales, emphasizing the fact

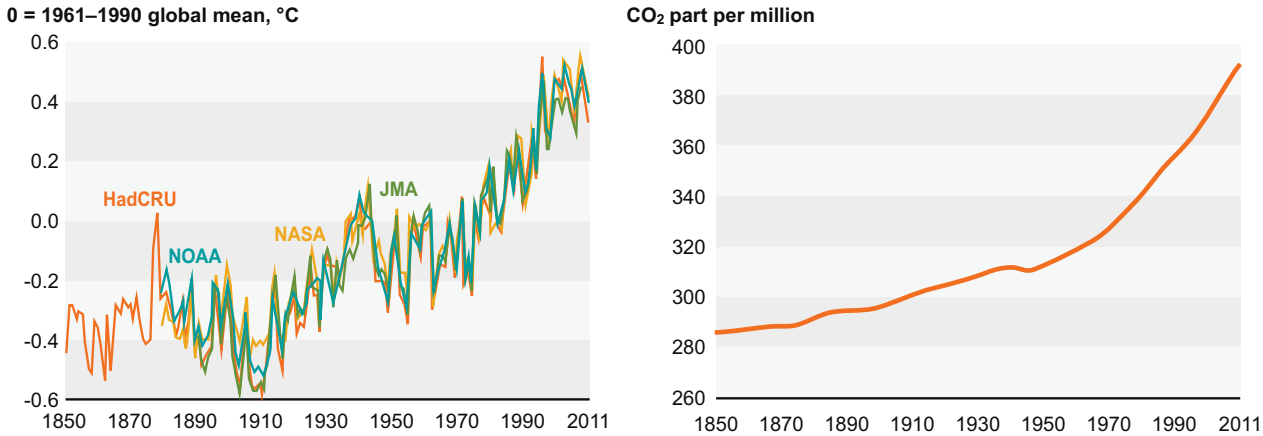

Fig. 3. Trends in temperature change and atmospheric CO_2 concentrations, 1850–2010. *Source*: Left panel – NOAA NCDC; NASA GISS; Hadley Climatic Research Unit at the University of East Anglia (HadCRU); Japan Meteorological Agency (JMA); Right panel – Scripps Institute of Oceanography, NOAA.

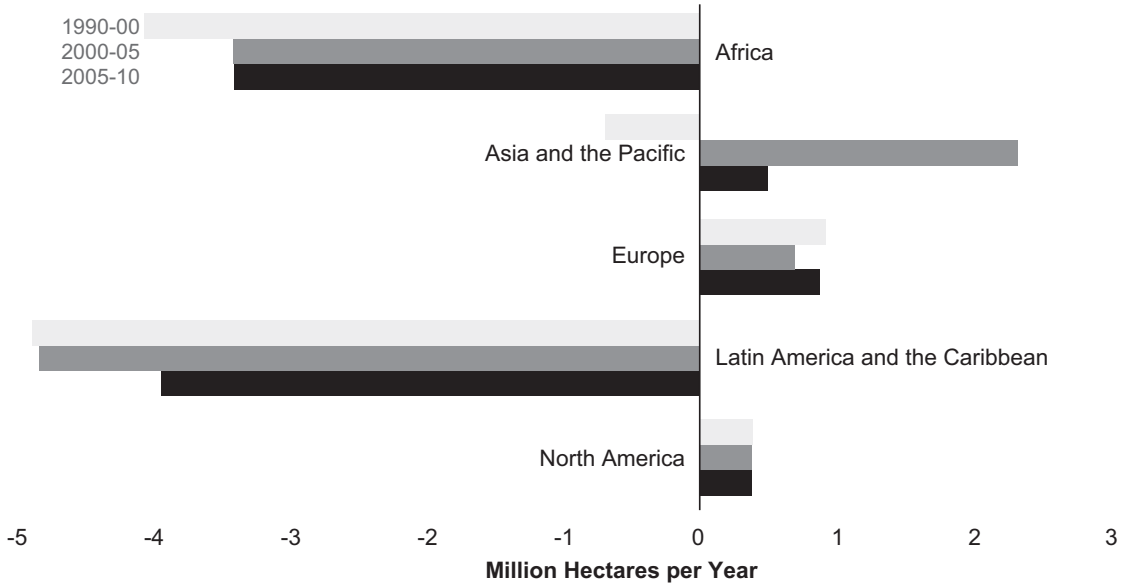

Fig. 4. Change in forest area by region, 1990–2010. *Source*: FAO, 2010.

that goals cannot be considered independently of each other. Also, the analysis of land related goals found that a number of important issues are not reflected in the current landscape of international goals. For example, there are no land-related goals or targets that reflect the unique vulnerabilities and challenges that exist in polar areas. Issues of capacity building and stakeholder participation are also inadequately represented in international goals. At the same time, several of the land-related goals that do exist lack quantifiable targets, complicating the task of assessing progress towards their achievement.

3.3. Water

Of the 30 environmental goals and objectives examined in relation to water in the GEO-5 assessment, only one goal shows 'significant progress', 12 goals are represented by 'some progress', there are four goals for which 'very little to no progress' has been achieved, and seven goals for which there is 'further deterioration'. The world is currently on track to achieve the MDG target of providing 87% of the global population with access to an improved water supply by 2015. Despite this achievement, more than 1 in 10 people (800 million) will still be without access to improved water sources in 2015, and 3.5 million people still die each year from water-related diseases. Over 2.5 billion people still lack access to

improved sanitation, and the MDG goal for improved sanitation by 2015 appears to be out of reach. Much remains to be done in vulnerable rural communities, especially in Africa and South Asia, which require solutions different from those for urban communities, including increased use of ecosystems for water purification. It is estimated that $72 billion is required in developing countries annually to meet the MDG target 10 on water supply and sanitation.

There has been very little or no progress in improving water security and equitable access to water. Against a background of continuing degradation and over-exploitation of water resources, the need for sustainable water supplies remains one of humanity's most critical resource needs (Fig. 5). There has also been little progress in reducing nutrient loads to freshwaters and coastal areas, or towards effective governance of areas beyond national jurisdictions, such as on the high seas. Furthermore, global scale monitoring of water quality, quantity, and ecosystem health has been reduced. As a result, there are increasing uncertainties associated with assessing the water environment, due both to data gaps and the rapidly-changing nature of water issues, including those related to climate change. The complexity of the drivers and associated pressures on the water environment is a key barrier to attaining internationally agreed goals. Lack of quantifiable targets for many environmental, socioeconomic and governance goals makes assessment of progress towards achieving water-related goals and sustainable ecosystems especially challenging. Other barriers include inadequate capacity, limited access to technology and funding, and information and data gaps.

3.4. Biodiversity

Internationally agreed goals related to biodiversity issues include those relating to habitat loss and degradation, fish stock, invasive alien species, extinction risk of species, sustainably managed production areas, protected area, equitable use of natural resources, and access and benefits sharing, and traditional knowledge. Of the 19 internationally agreed biodiversity goals and objectives examined in GEO-5, ten show 'little to no progress'. Although there has been much global interest in halting the loss and degradation of biodiversity, there has not been much success. The overall outlook reveals little evidence of improvement; biodiversity loss continues at a dangerous rate (Fig. 6). At the species level, current trajectories indicate that even more species are threatened by extinction, with extinction ranges from 13–63% and averaging almost 20% for vertebrates. The levels of threat are increasing fastest for corals—where the global decline of coral reefs since 1980 is nearly 38%. The condition and extent of natural habitats

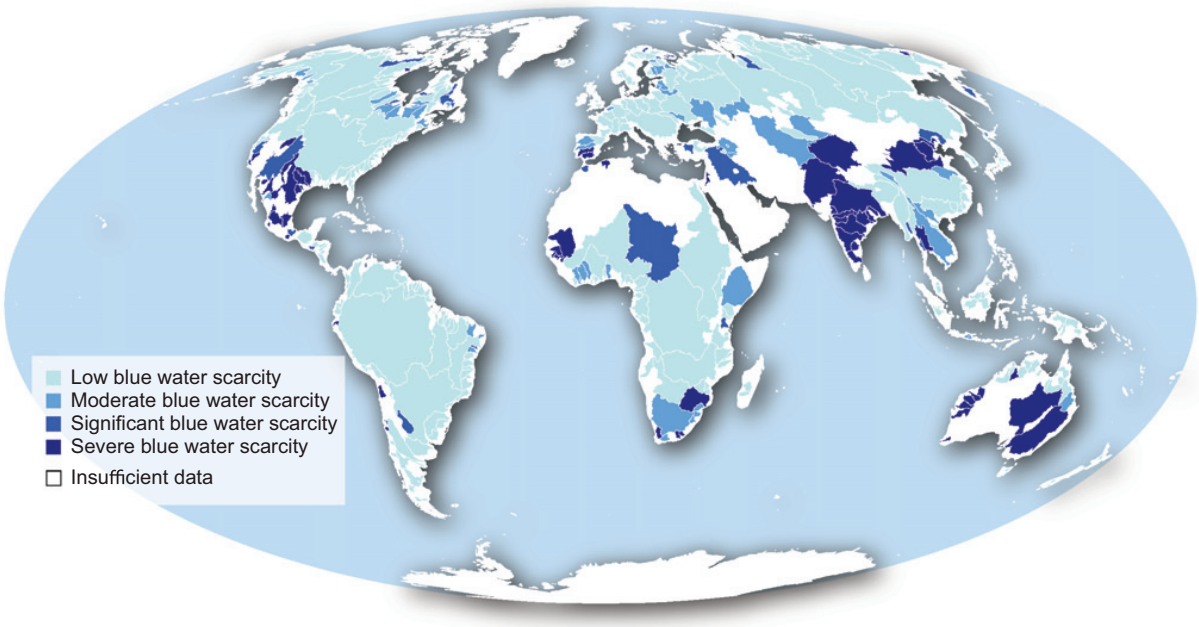

Fig. 5. Annual average water scarcity in major river basins, 1996–2005. *Note*: The annual average is calculated from monthly values. *Source*: Hoekstra and Mekonnen, 2011.

continue to decline, with some areas experiencing declines of 20% or more since 1980. The proportion of overexploited, depleted or recovering marine fish stocks has more than tripled between 1974 and 2008.

There is a general increase in the pressure from pollutants although some progress is seen in the reduction of pressure from certain pollutants in some regions. There are also detectable trends in the impacts of climate change that include increasing disruption in phenology, abundance, distribution, and community composition in all ecosystems.

Areas where goals are being partially met include: increases in the designation of protected areas (now covering nearly 13% of land area, but less than 1.5% of marine area); increasing recognition of indigenous community managed areas; adoption of policies and actions for managing invasive alien species and genetically modified organisms, regulating sustainable harvests and reducing pollution; specific cases of species recoveries and habitat restoration. There is also some progress towards enhancing the equitable access and benefit sharing of genetic resources.

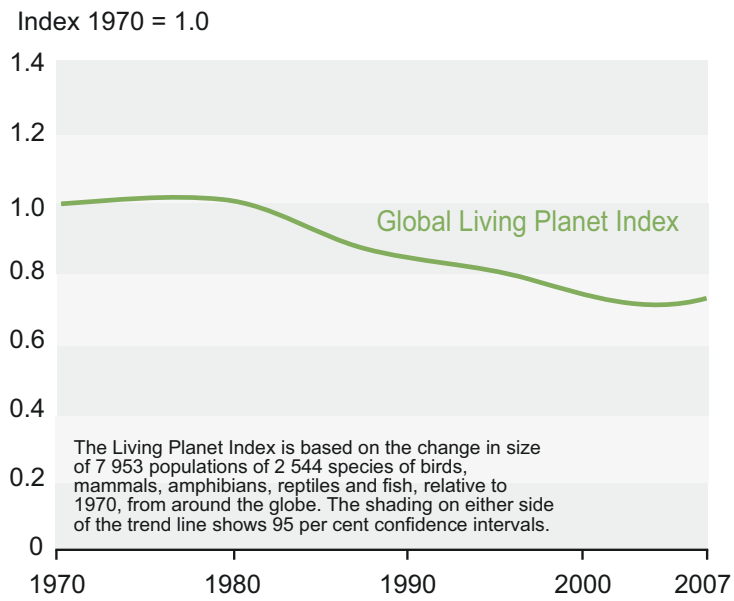

Fig. 6. Global Living Planet index (based on the change in size of 7953 populations of 2544 species of birds, mammals, amphibians, reptiles and fish, relative to 1970, from around the globe. Dotted lines show 95% confidence intervals).
Source: Loh, 2010.

3.5. Chemicals and waste

Internationally agreed goals related to chemicals and waste include those relating to protection of marine environments, control of persistent organic pollutants, shared responsibility and cooperation related to the international trade of hazardous chemicals, approaches to managing radioactive wastes, and technical and capacity support for countries in need. Of the 23 goals and objectives related to chemicals and waste analyzed in the GEO-5 assessment, significant progress was made in the achievement of only one goal: improving research in order to prevent, eliminate and reduce pollution of the marine environment. There were 11 goals for which some progress has been observed and three goals for which there is very little or no progress. The remaining eight goals could not be properly assessed due to insufficient information.

Where better management of toxic and other hazardous chemicals is needed, the lack of information is of paramount concern. While there is a growing body of scientific knowledge on the impacts of chemicals and wastes on humans and the environment, this knowledge remains incomplete and in some cases seriously lacking due to limited data and information on uses, emissions, exposure pathways and effects of chemicals mixtures. The results suggest that long-term monitoring programs for persistent organic pollutants in environmental media and human tissue

Table 2
Summary of progress toward environmental goals.

	Deterioration	Very little to no progress	Some progress	Significant progress	Insufficient data	Too soon to assess	**Total**
Atmosphere	0	2	5	2	0	0	**9**
Land	0	5	4	0	0	0	**9**
Water	7	4	12	1	6	0	**30**
Biodiversity	0	10	8	0	1	0	**19**
Chemicals & waste	0	3	11	1	7	1	**23**
Total	**7**	**24**	**40**	**4**	**14**	**1**	**90**

Results of GEO-5 thematic chapters in assessing progress toward selected environmental goals and objectives based on the latest available data.

need to be maintained and expanded, in particular in the southern hemisphere. These initiatives are essential for a better understanding of the time trends of global chemical pollution and for the effectiveness evaluation of the Stockholm Convention on persistent organic pollutants. In addition to scientific knowledge gaps, sound chemicals and waste management is also hampered by the lack of resources, capacity, and compliance monitoring, as well as the lack of education and training on the appropriate management of chemicals and wastes in many developing countries. Furthermore, increased trade resulting from free trade agreements is complicating this picture as it may well exert even more pressure on emerging economies with respect to regulating or restricting chemical use.

4. Discussion: challenges in meeting internationally agreed goals

Building on the analysis from GEO-5 presented above, the following sections discuss key obstacles that have hindered the achievement of internationally agreed environmental goals. These can be considered as a series of mismatches or discontinuities that interfere with adopting the integrated approaches, long-term perspectives and collaborative actions that would be needed to attain these goals. The analysis of the combined effect of these mismatches can help us understand the limitations of current approaches to meet internationally agreed goals.

4.1. Focus on economic priorities over environmental ones in the operationalization of development

The continuous search for economic growth has dominated international, national, and local development agendas. Policies have been oriented to support economic growth and governments have shifted from a managerial to an entrepreneurial orientation often neglecting environmental priorities (Jackson, 2009a, 2009b). The mismatch between economic and environmental priorities is one of the elements that help in understanding the pace and scale of global environmental change. In the view of some scholars, this change is challenging the resilience of the earth system and the ability to maintain livelihoods and support human development (Rockström et al., 2009; Steffen et al., 2011).

Despite international attention given to sustainable development since 1992 as a normative concept seeking to balance – and ideally, integrate – economic, social, and environmental priorities, 20 years later that attention has diluted and societies are in search of new paradigms to improve their interactions with the environment. There have been positive contributions to improving the balance between economic and environmental priorities (Pearce and Turner, 1990; Cropper and Oates, 1992; Pearce, Atkinson., 1993; Daly and Cobb, 1994; Hawken, 1994; Ayres, 1996; Ayres and Ayres, 1996; Stahel, 1997, 2006; Ostrom et al., 1999; MA, 2005; Cato, 2009; Kumar, 2010). For example, the emergence of environmental economics as a subdiscipline seeking to provide an economic value to environmental considerations, ecological economics as an effort to address the interactions between economic systems and ecosystems over time and space, and the Millennium

Ecosystem Assessment raising awareness of the importance and value of ecosystem services, are positive steps in this direction. More recently, the OECD's Measuring the Progress of Societies initiative (Hall et al., 2010) and UNEP's Green Economy Initiative (UNEP, 2011b) have stimulated important discussion on the development of environmental and social indicators and aggregate indices to complement GDP and traditional national accounts that are now beginning to be applied.

Despite these and other contributions, environmental concerns continue to be subordinated to economic growth in national and local development plans, policies, and strategies. At the same time, the implementation of MEAs is constrained by limited political will, the dominance of free trade ideology, economic and financial crises, and the still embryonic emergence of new governance approaches to foster sustainable development processes.

4.2. Types of problems vs. types of responses

Responses to sustainability challenges are often not well matched to the kinds of problems that these challenges represent. This mismatch has two dimensions: (1) response strategies do not sufficiently address the complexity of the problems; and (2) problems and solutions frequently play out over different spatial, temporal and jurisdictional scales while cross-scale interactions are not adequately considered.

Zaccai (2012) describes how the types of "iconic" issues dominating the international environmental governance agenda have changed over time. In the 1980s and 1990s an emphasis on pollution and waste problems meant that it was relatively easy to define the source of the problem and design corrective action. In contrast, challenges currently considered as most urgent are more complex and diffuse issues such as climate change and biodiversity loss (Zaccai, 2012). One consequence of this shift is that strategies that led to past successes in controlling particular pollutants, such as ozone depleting substances or lead in gasoline, are not as applicable to issues with more dynamic patterns of causality and interactions between drivers.

For some issues the changing nature of environmental problems means that responses are absent altogether. One such area where strategies are lacking involves anticipating and handling the non-linear changes associated with tipping points, while another concerns addressing the unique challenges presented by emerging technologies (Biermann et al., 2012).

The mismatch between problems and strategies extends to issues of scale in environmental governance. Tensions between problems and responses are evident on temporal, spatial and jurisdictional scales (Hisschemöller and Gupta, 1999; Cash et al., 2006; Nilsson and Persson, 2012). Regarding temporal scales, governments and private sector actors tend to be driven by short-term electoral or financial cycles, giving them little incentive to take action on problems that are expected to unfold over long time periods (Cash et al., 2006). At the same time, "slow-motion" responses are not keeping up with quickly changing biophysical and socio-economic processes.

The alignment of spatial and jurisdictional levels, particularly for transboundary environmental problems, tends to be poor. In terms of jurisdictions, top-down and bottom-up responses are generally not well connected. Much of the work on multilateral environmental agreements has taken the form of a global, top-down approach. There has been relatively little attempt to link efforts at the local, national and international levels, in terms of both information about impacts and compliance. A decentralization of power in many parts of the world has occurred without the creation of clear links between the different levels of government and international bodies (Dodds, 2002), and to a large extent without changing the existing patterns of influence by centralized actors (Young, 2006).

Economic globalization and its accompanying influence on transnational corporations since the 1992 Rio Earth Summit has produced a particular challenge for environmental governance across jurisdictional levels. While regulation on companies' behaviour to control negative impacts on the environment may be seen as acceptable at a national level, at a global level it is incredibly challenging to regulate industrial activities in the name of environmental protection (Dodds, 2002). Integration across jurisdictional levels is discussed further in the section on the fragmentation of governance below (Section 4.5).

4.3. Responsibilities vs. resources of environmental institutions

Environmental institutions at different levels are expected to bear great responsibility for implementing agreements. This is, however, out of proportion to the level of power, resources and in some cases capacity that these institutions often have. Global institutions that are working to promote sustainability face particular challenges related to authority and coordination, while at the national level, ministries of the environment frequently lack the capacity and clout needed to fully engage in the implementation of environmental agreements.

One of the two main themes for the Rio+20 Earth Summit is the 'institutional framework for sustainable development'. This primarily refers to the system of global governance for sustainable development, which includes the global institutions charged with developing, monitoring and implementing policies on sustainable development across its three pillars—social, environmental and economic (Young, 2010). The two main institutions governing sustainable development at the global level are the United Nations Environment Programme (UNEP), established in 1972 as a result of the Stockholm Conference, and the Commission on Sustainable Development (CSD), created in 1992 to ensure effective follow-up to the Rio Earth Summit. Many attempts have been made to clarify the roles and relationships between and among the CSD, UNEP, the UN Development Programme, and other UN programmes and agencies (Roch and Perrez, 2005), as well as the various other mechanisms within the UN such as the Inter-Agency Committee on Sustainable Development; the interagency mechanisms of UN Oceans, UN Water, and UN Energy; and the Environmental Management Group (UNCSD, 2011).

A considerable amount of analysis has assessed the effectiveness of global governance for sustainable development, not all of it favorable. Many stress that the failure to halt or reverse global environmental degradation is evidence of the inherent adequacies of the global governance system (Oberthür and Stokke, 2011; Galaz et al., 2012). Due to its limited mandate and status as a UN 'Programme' rather than a Specialized Agency, UNEP has lacked the necessary authority to mainstream environmental considerations throughout the UN system. There has also been a certain overlap of scope and mandate between the CSD and UNEP, encouraging competition rather than collaboration, yet with neither possessing the necessary status to accelerate the required global changes to achieve sustainable development (Andresen, 2007a; Biermann, 2011).

Discussion and debate about the reform of International Environmental Governance in the context of Global Governance for Sustainable Development is ongoing (Ivanova, 2007; Ivanova et al., 2007; Ellyard, 2011; Ivanova, 2011; HLPGS 2011a, 2011b, 2011c; Biermann et al., 2012; Andonova and Hoffmann, 2012; Ivanova, 2012; UNCSD, 2012; Zaccai, 2012; UNEP, 2012a). Since the World Summit on Sustainable Development (WSSD) in 2002, little progress has been made in relation to the required institutional architecture that would propel global environmental and sustainable development issues into the 21st century. While the World Summit on Sustainable Development heralded a new era of action-orientated 'partnerships' for sustainable development, it is recognized that despite the considerable success of some of these partnership programmes, they have not delivered the systemic change needed in global governance. It is therefore hoped that the focus on 'the institutional architecture for sustainable development' for Rio+20 presents an unprecedented opportunity to spur progress towards a more effective global system for delivering sustainable development objectives (Biermann et al., 2012).

4.3.1. Country-level capacity

In the Millennium Report, the Secretary-General of the United Nations highlighted that "Support for the rule of law would be enhanced if countries signed and ratified international treaties and conventions", but that many countries are unable to engage effectively owing to "the lack of institutional capacity and resources" (UN, 2011). The lack of sufficient capacity and authority of environmental ministries in most countries hinders the effective implementation of global policy instruments at the national level and prevents countries from seizing the constructive opportunities that international mechanisms can provide.

States, especially developing countries, struggle to meet institutional demands as the number of institutions increases. Participation in global environmental governance represents a challenge as countries use scarce resources to participate in negotiations and meetings, and to satisfy reporting requirements and other MEA demands. Overstretched human and financial resources needed for

global governance leave developing countries with fewer resources for implementation or the mitigation of environmental threats of most concern to them. For example, harmonizing national reporting on biodiversity-related conventions has been pursued, but this has been difficult, and given the structure of the "harmonized" process, it remains unclear exactly how it improves the implementation of conventions at the national level or saves national resources (Najam et al., 2006).

Many instruments have failed to develop implementation mechanisms that consider the different capacity level of countries. Countries at different levels of development require different kinds of institutional support and financial and technical assistance in order to implement convention obligations. This aspect has been increasingly recognized as important, and in recently negotiated instruments the linkage between assistance by developed countries and compliance by developing countries and countries in economic transition has been more strongly stated. For example, the Stockholm Convention on Persistent Organic Pollutants Article 12 on technical assistance states that "The Parties recognize that rendering of timely and appropriate technical assistance in response to requests from developing country Parties and Parties with economies in transition is essential to the successful implementation of this Convention".

Access to a proper funding mechanism under a convention has a direct impact on its implementation; conventions with a dedicated financial mechanism tend to be more successful than others. The Montreal Protocol on ozone depleting substances, one of the most successful agreements to date, has its own Trust fund, which provides support to developing countries and countries in economic transition at both institutional and industrial investment levels. Four other MEAs (the Convention on Biological Diversity, the UN Framework Convention on Climate Change, the UN Convention to Combat Desertification and the Stockholm Convention on Persistent Organic Pollutants) use the Global Environment Facility (GEF) as a financial mechanism and experience some degree of implementation, which paves the way to success. The Ramsar Convention of Wetlands of International Importance has established three targeted funding mechanisms to assist Parties in implementing the convention: (1) a Small Grants Fund for Wetland Conservation and Wise Use (a global program), (2) Wetlands for the Future (a program for Latin America and the Caribbean), and (3) the Swiss Grant Fund for Africa. In addition, private sources and bilateral donors frequently provide financial resources to protect and manage wetlands. These funding mechanisms can help to address shortfalls in capacity for environmental governance at the country level and increase the chances that environmental agreements will be successfully implemented.

4.4. Disconnect between science and policy

The science-policy interface in the field of international environmental governance reveals a fundamental mismatch between the empirical evidence for a call to action on environmental issues by the science community and the inertia of environmental policy-making processes. As demonstrated in numerous ongoing intergovernmental negotiations (e.g., the UNFCCC process), the challenge of transforming the near-consensus recommendations from science into practical policies and actions is formidable.

The scientific community has created significant contributions improving the state of knowledge about global environmental change. Yet only a fraction of that knowledge is used in the design of policies and strategies to address international, regional, and local environmental problems. The science and policy communities operate with different cultures, interests, ideologies, expectations, and time-scales, and communication between them is often scarce, fragile or inexistent. Better knowledge of global environmental problems has not fostered more effective MEAs or better national and local environmental strategies and policies.

A vast body of literature and experience demonstrates that there is no clear, natural or easy fit between the world of science and that of environmental decision-making processes, or more precisely, policy (Sarewitz and Pielke, 2007; Young, 2008; National Research Council (NRC), 2009; UNEP, 2011b). However, concerns about the role of science in the study of global environmental change have fostered fresh ideas for reducing the divide between science and policy/practice. These efforts recognize the need to transcend disciplinary boundaries and reductionist and positivist approaches to science for a new approach to the generation of knowledge that includes a balanced and dynamic participation of stakeholders (Dietz et al., 2003; Robertson and Hull, 2003; Bammer,

2005, 2008; Næss et al., 2006; Roux et al., 2006; Turnhout et al., 2007; Huitemaa and Turnhoutb, 2009; Rosa et al., 2010). Although there are encouraging initiatives illustrating the benefits of a close collaboration between the scientific and policy communities (for example in building climate change mitigation and adaptation actions in some urban areas), much remains to be done to make a broader use of available knowledge in addressing global environmental change.

4.5. Fragmentation of governance vs. collective responses

The proliferation of environmental agreements has contributed to an increasingly fragmented landscape of governance institutions and proposed solutions which has arguably become as daunting a challenge as the problems that the solutions were designed to address (Najam et al., 2006; Andresen, 2007b; Kanie, 2007; Bernstein and Pauly, 2008; Biermann et al., 2009; Zelli et al., 2011). When negotiating existing agreements, there was little recognition of relationships between the different areas. Instead, an atmosphere of competition – for funds, staff, and attention – was in some instances even encouraged. This has resulted in considerable fragmentation of the sustainability agenda (Dodds, 2002, Zelli 2011). Most of the new agreements have established independent bureaucracies and this proliferation has dispersed authority in international environmental governance.

The fragmentation of environmental institutions not only relates to issues of geographical dispersion, but also to such problems as inconsistency of norms and rules, and of differing political and normative contexts. Fragmentation thus relates to discrepancies and overlaps between the agendas of thematically equivalent regional and world-wide bodies as much as it relates to problems of duplication of work between global institutions with very different agendas (Knigge et al., 2005).

Although the establishment of environmental agreements and institutions is to be welcomed, it has become increasingly clear in recent years that the plethora of instruments and actors concerned with environmental protection gives rise to problems of governance. While governments may often agree with the principles promoted in the agreements and have the good will and desire to implement their obligations, the reality has been that many have felt overwhelmed by the multiplicity of obligations they have incurred under multilateral environmental agreements. Not surprisingly, in many countries with limited international policy capacity, this multitude of forums has hampered implementation.

Synergy can be achieved through strengthening cooperation between institutions and administrations involved in implementation and enforcement, development of coordinated legislation, improved information provision and exchange between Secretariats, governments, industry and civil society, coordination among focal points in monitoring and enforcement, coordinated capacity building and trainings. One recent effort to achieve synergy between MEAs was implemented in 2010 by the three Conventions (Basel, Rotterdam and Stockholm Conventions) that promote sound management of hazardous chemicals and wastes under the auspices of UNEP. The process aims to strengthen ties between the conventions, and better target resources for chemicals and waste management on regional and national level. It is anticipated that this joint effort will lead to enhanced implementation of the Conventions and compliance by Parties.

4.6. Complex systems vs. measurability of outcomes

Those environmental agreements for which specific, numerical targets were set have been relatively successful. Already in the 1960s, for example, the World Commission on Protected Areas (WCPA) set a target of 10% of global land area to be designated as formally protected; today, nearly 13% of the world's surface has been set aside as protected. Similarly, the Montreal Protocol on Substances that Deplete the Ozone Layer defines mandatory targets and specific timeframes within which the required reductions must be met and it conducts regular reviews of phase-outs in accordance with scientific updates. It is critical to have baseline information to allow progress towards the targets to be tracked. One of the obstacles to achieving environmental goals in many cases is the lack of sufficient data and monitoring systems to measure progress. Every GEO-5 author team noted the lack of availability of basic data sets. Even when data is available, analysis and interpretation within appropriate contexts are often lacking.

Relatively little measurable progress has been made – or can be demonstrated – towards the WSSD target to "reverse the loss of biodiversity by 2010", where there is no reliable baseline information on the amount of biodiversity on which to base trends and assess progress. More recently the Nagoya targets set under the Convention of Biological Diversity also have no clear numerical goals. When specific quantitative goals are absent, targets may read more like recommendations. When goals incorporate numerical levels or values, the required achievement is more clearly defined and potentially obtainable. In fact, empirical evidence shows that goal-setting can work when clear quantitative targets are set (UNEP, 2012a; UNEP, 2011c).

However, the presence of clear and quantified targets is no guarantee of success. Climate change mitigation has had numerical targets for many years in the form of greenhouse gas emission reductions spelled out in the Kyoto Protocol, but the vast majority of countries that adopted these legally binding targets have not come close to meeting them. This example highlights another lesson learned from the history of environmental target-setting: that it works best for well-defined issues, such as the phasing out of Ozone Depleting Substances or leaded gasoline, and for issues related to industrial chemicals for which technologies exist or can be developed. In other words, the nature of environmental problems themselves influences how easily they can be governed using international goals and strategies. Since efforts to reduce greenhouse gas emissions rely on changing energy and land use patterns that are deeply embedded, pervade many human activities and for which a technological substitution is not always readily available, numerical targets alone have not been enough to motivate action to the level of goal achievement on this issue.

4.6.1. Compliance and verification tools

Few of the Multilateral Environmental Agreements (MEAs) have specific compliance mechanisms, and even the ones that exist are relatively weak, as few countries are prepared to submit themselves to an independent review of compliance with convention requirements.

There is a lack of support for countries to create the adequate laws, or to set up proper verification mechanisms for the enforcement of MEAs. In essence enactment of agreements depends on 'political will' by countries to do their 'best'. This does not work in most cases. Even if it is possible to show that a country has not complied it is unlikely that the convention secretariat will call them to account. The principle pressure comes from those stakeholders who can use the media or publish reports, which embarrass countries in front of their peer group. There are mechanisms outside the environment sector that have formalized this (e.g., CEDAW). The situation will only change if the environmental conventions develop legally binding agreements on compliance that can be enforced internationally with proper sanctions—a 'rules-based governance' system.

Assessing the effectiveness of international environmental agreements requires verification of compliance, agreements that are verifiable being more likely to succeed than others. The process of verification builds confidence and improves the prospects for future cooperation. Verification produces information that can provide the technical basis for future agreements and shared understanding as well as the basis for sanctions. MEAs recognize the importance of this process and many employ some form of implementation review in which the performance of governments in implementing their commitments is evaluated. The reviews however use different methods, ranging from loose compilation of national reports to stricter compliance mechanisms, based on monitoring, reporting, and assessing environmental and socio-economic statistical data.

The "non-compliance" provisions have been difficult to get agreement on in MEAs negotiations and have often remained inconclusive or weak, excluding formal arbitration mechanisms. In the absence of enforcement mechanism, governments in both the industrial and developing world can evade responsibility for the environmental consequences of their actions. The less rigorous national reporting in place for most MEAs is usually performed through gathering and distribution of national reports by the relevant secretariat, with little or no analysis.

The Montreal Protocol and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) contain the most extensive and formalized review institutions and the Convention on Migratory Species and the Convention to Combat Desertification the least. The first two agreements are often cited as the most successful ones (Raustiala, 2001).

Newer MEAs exhibit a greater tendency toward the development of review processes, and there is evidence that review mechanisms are most developed where MEA commitments are most specific. The Stockholm Convention on Persistent Organic Pollutants includes a provision for effectiveness evaluation of the convention, which encompasses a global monitoring program of POPs in the environment. The UNFCCC has also begun with the negotiation of the Kyoto Protocol to create more specific, concrete commitments and is now beginning to establish the institutions necessary to review compliance with them.

One of the interesting findings of GEO-5 suggests a tendency in the last twenty years for some environmental agreements to use trade mechanisms in order to ensure compliance. Two such treaties are the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and the 1991 Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal. In some cases, individual nations have tried to enforce their environmental standards using trade sanctions (e.g., the U.S. embargo on tuna products from Mexico). Some authors consider this could provide an argument for stronger enforcement for future conventions (Dodds, 2002). However, other authors doubt trade sanctions would result in environmental benefits (Muradian and Martinez-Alier, 2001; Yu et al., 2002). Despite the attention provided to interactions between trade and the MEAs during the last decade, there is still need for a broader understanding of this complex relationship. This is particularly relevant in light of current efforts to create more efficient approaches to address global environmental change.

5. Conclusion

In the 40 years between Stockholm and Rio+20, environmental concerns have been identified, solutions drafted and commitments made many times over. In May 2011, IUCN President Ashok Khosla stated that Rio+20 needs to review 40 years of unfulfilled commitments and explore genuine alternatives to current practices. Such unfulfilled commitments are reflected in a deterioration of environmental conditions in many areas including climate change, biodiversity loss and disruptions to the nitrogen cycle, all of which carry a risk of irreversible changes.

In its analysis, GEO-5 demonstrates that the international community has, over the past 40 years, typically concentrated on reducing pressures, the symptoms of degradation. There are, however, compelling reasons to take a fresh look at the fundamental drivers of environmental change as an appropriate focus in redefining the approach to address persistent environmental problems. The analysis of biophysical trends in GEO-5 helps connect these problems with the limited success so far in achieving internationally agreed environmental goals.

The analysis presented in this paper reiterates the clear need for improved policy responses. It finds that a number of critical mismatches are impeding the achievement of environmental goals. Improving this situation is likely to require considerable transformations, not only in thinking, but in the ways people live their lives. Moving on to such a path will require substantial political leadership combined with the application of adaptive approaches in governance - at every level from the local to the global. Redefining the approach to addressing global environmental problems should also consider how internationally agreed goals are defined, how closely they match environmental and social needs, and how they could be updated to reflect dynamic changes in biophysical and social processes.

A new approach could focus on a realistic number of goals that can be monitored and encourage the development of enforcement mechanisms to increase the number of countries meeting them. International organizations (the UN family, GEF, The World Bank and others) can play a key role in creating new approaches for addressing global environmental change. Closing the gap between the science and policy communities will be a crucial step in helping to define new patterns of green growth and opportunities for sustainable development.

Overcoming the obstacles outlined here is both the opportunity and the challenge for Rio+20. This will require achieving an improved understanding of the transformations needed to tackle the fundamental drivers of environmental change, mobilizing the necessary political will, and identifying, targeting and coordinating the resources needed to begin the process of transformational change.

The cost of inaction is high, the global environment and the people who depend on it cannot wait another 40 years before decisive and coordinated action is taken.

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