Environmental Paradigm Gap

| | by TIMOTHY JOHNSON | |

University of Massachusetts at Boston

McCormack Graduate School of Policy and Global Studies

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i. Abstract

Global environmental degradation and climate change threaten the health of planetary systems and the security of states while necessitating clean and sustainable development in the industrializing world. In the past three decades, the international community has articulated its goals for addressing these issues in a series of global environmental protocols; these agreements represent the culmination of international efforts to halt or reverse this degradation. This essay summarizes five major global protocols during this period, and the goals they set for greenhouse gas (GHG) emissions reductions, funding, and technology transfers. By focusing on the Clean Development Mechanism (CDM) established in the Kyoto Protocol to track these variables, the essay analyzes whether a gap exists between the policies as established in these global agreements and their implementation, and finds evidence of such a gap. The essay concludes by highlighting some possibilities for closing this environmental paradigm gap, namely increased waste management efficiency through conservation, composting, and expanded support for the informal waste management sector. These recommendations can empower the individual to become a central actor in limiting global GHG emissions and thus environmental degradation.

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I.

A Narrative of Climate Change and its Significance to International Relations

I.A.

Conceptualization

Ten years ago, definitive working definitions and usages of the term *climate change* emerged, as understood by both the Intergovernmental Panel on Climate Change (IPCC) and the Framework Convention on Climate Change (FCCC):

> "Climate Change in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."
>
> (IPCC *Physical Science Basis* 2007: 2)

This 2007 document of the IPCC – *Climate Change 2007: The Physical Science Basis* – also outlined Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O) as main greenhouse gases (GHGs) while stating that "global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750." (IPCC *Physical Science Basis* 2007: 2) According to the IPCC, "fossil fuel and land-use change" account for the carbon dioxide increases; the agriculture industry drives accumulations of methane and nitrous oxide; and carbon dioxide is "the most important anthropogenic greenhouse gas (see Figure SPM-2)." (IPCC *Physical Science Basis* 2007: 2)

NASA (2005) defined GHG as "gases that trap heat in our atmosphere," further elaborating that "molecule for molecule, methane is 20 times more potent than carbon dioxide as a greenhouse gas, but CO_2 is much more abundant than methane and the predicted growth rate is far greater." (NASA 2005) The NASA report shows the relevance of spotlighting methane emissions in addition to focusing on CO_2 accumulation in the atmosphere, especially as "sources of methane include natural sources like wetlands, gas hydrates in the ocean floor, permafrost, termites, oceans, freshwater bodies, and non-wetland soils. Fossil fuels, cattle, landfills and rice paddies are the main human-related sources." (NASA 2005)

In addition to details of GHGs, the *Physical Science Basis* also stated, under the heading *Direct Observations of Recent Climate Change*, that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." (IPCC *Physical Science Basis* 2007: 5) The report noted increases in "average Arctic temperatures;" "more intense and longer droughts;" an uprising in "the frequency of heavy precipitation events;" and "widespread changes in extreme temperatures," to spotlight a few focal points. (IPCC *Physical Science Basis* 2007: 8) These factors elucidate the concept of *climate change* and outline some of its pertinent and pressing challenges.

In 2007 the IPCC also released *Climate Change 2007: Mitigation,* which frame-worked the variables for measuring and conceptualizing climate change. Some of the main angles covered by the IPCC *Mitigation* help in visualizing and understanding the scope of the key issues, including:

- mitigation (from the long-term context, from a cross-sectoral perspective, and in terms of sustainable development);
- energy supply (which would affect transport and its infrastructure and also residential and commercial buildings);
- industry;
- agriculture;
- forestry; and
- waste management

(IPCC *Mitigation* 2007: Contents/Technical Summary section)

Magdoff and Bellamy Foster (2010) illustrated the related concept of *planetary boundaries*, or "nine critical boundaries/thresholds of the earth system." (Magdoff and Bellamy Foster 2010: 12) These boundaries give some sense of the all-encompassing nature of dangers facing the environment, which intertwine with each other:

1. climate change;
2. ocean acidification;
3. stratospheric ozone depletion;
4. the biogeochemical flow boundary (the nitrogen cycle and the phosphorous cycles);
5. global freshwater use;
6. change in land use;
7. biodiversity loss;
8. atmospheric aerosol loading; and
9. chemical pollution

(Magdoff and Bellamy Foster 2010: 12)

These definitions of *climate change*, *GHGs* and *planetary boundaries* set the baseline definition for *global environmental degradation*.

I.B.

Security Threats and/or Concerns

National security questions overlap concerns of environmental degradation, from issues of vulnerable states to enforcement of international agreements to resource and energy supply security. Droughts, floods, and high-intensity storms rock the developed and developing world alike, forcing the international relations community to take notice of environmental issues to the same degree it recognizes human rights, health, trade, finance, and other global governance issues.

Podesta and Ogden (2008) outline the danger of "the domino of the first major climate change consequence, whether it be food scarcity or the outbreak of disease;" (Podesta and Ogden

2008: 116) the falling of these *dominos* would portend "cascading geopolitical implications" (Podesta and Ogden 2008: 116) stemming from climate change complications. Nigeria, for example – a country at particular risk of suffering "from climate-induced drought, desertification, and sea-level rise" (Podesta and Ogden 2008: 119) – exemplifies this scenario. As *climate-induced migration* "will be most pronounced in the developing world" and "will widen the wealth gap between and within many of these countries," (Podesta and Ogden 2008: 117) climate issues compounded by population growth in Nigeria "will force significant migration and contribute to political and economic turmoil." (Podesta and Ogden 2008: 119)

Vulnerable states such as Nigeria bear a small portion of the responsibility for atmospheric GHG concentrations in comparison to the developed world. Nevertheless, "the biggest catastrophic impacts will be on developing countries, such as Mali and Bangladesh, that are not driving the problem," (Pascual and Zambetakis 2010: 23) an issue with no simple solution. Chapter Two analyzes three decades of global environmental protocols attempting to address sticky issues such as these; in the meantime, the most at-risk states suffer the brunt of the effects of environmental degradation, while simultaneously expected to "share the cost of avoiding or responding to the problem" (Pascual and Zambetakis 2010: 23) and to mitigate the negative effects.

How can the international community bridge security threats? Clearly, as Kenderdine and Moniz (2013) summarize, "the empirical evidence of anthropogenic climate change continues to grow. The evidence argues for adaptation strategies in addition to strategies of carbon dioxide (CO_2) mitigation, such as support for renewable technologies, which meets multiple policy objectives." (Kenderdine and Moniz 2013: 380) The global environmental protocols cited in Chapter Two similarly promote adaptation and mitigation strategies such as technology transfers, yet lack any authority mechanism for enforcement of these policies.

Kenderdine and Moniz look closely at CO_2 emissions and the details of anthropogenic CO_2 emissions, concluding that:

> "the most direct way to minimize climate change impacts and reduce the associated risks is to dramatically reduce GHG emissions into the atmosphere. More than 30 billion tons of anthropogenic CO_2 is emitted globally each year, making CO_2 the GHG of principal concern. CO_2 also has a long residence time in the atmosphere, measured in centuries, relative to other GHGs."
>
> (Kenderdine and Moniz 2013: 398)

The authors call for international coalitions to spearhead these efforts and to aid in implementation and the enforcement of commitments, in particular by the BRIC (Brazil, Russia, India, China) and MIST (Mexico, Indonesia, South Korea, Turkey) countries. (Kenderdine and Moniz 2013: 398)

The issue of international alliances as mechanisms for enforcement run up against similar challenges, as security concerns resonate with the global international relations community and raise questions of *sovereignty* and access to resources. Heightened competition for ever-scarcer resources results from climate change and environmental degradation. Dupont (2008) relates the following:

> "China has redoubled its efforts to redirect the southward flow of rivers from the water-rich Tibetan plateau to water-deficient areas of northern China. The problem is that rivers like the Mekong, Ganges, Brahmaputra and Salween flow through multiple states. China's efforts to rectify its own emerging water and energy problems indirectly threaten the livelihoods of many millions of people in downstream, riparian states. Chinese dams on the Mekong are already reducing flows to Myanmar, Thailand, Laos, Cambodia and Vietnam. India is concerned about Chinese plans to channel the waters of the Brahmaputra to the over-used and increasingly desiccated Yellow River."
>
> (Dupont 2008: 34)

In addition to tensions over water access security, Dupont discusses the disappearance of "late summer Arctic ice" and the security implications of this for "the five claimant states – Russia, the United States, Canada, Denmark and Norway," (Dupont 2008: 37) the five countries bordering the Arctic. The potential availability of vast deposits of fossil fuel wealth as the Arctic ice sheets melt will raise questions of access, resource grabs, and might versus rights. Global warming through climate change in this sense squarely impacts the international relations arena and some of its key stakeholders.

The Arctic example hints at the issue of energy supply. Each state seeks energy or resource security, a consistent energy supply, and the capacity for energy independence; climate change adds stress to these concerns. States (and their corporate partners) have thus developed new methods of extracting fossil fuels such as *hydraulic fracturing* (also known as *fracking*) due to the onset of resource scarcity and concerns such as *peak oil*, in the quest for steady supplies.

Fracking, however – and other dirty or risky extraction projects such as the vast Alberta tar sands in Canada – exacerbates climate change while causing widespread environmental degradation such as pipeline spills and possibly even earthquakes. Fracking extracts natural gas, the main component of which is methane, a more powerful GHG than CO_2. (Fuerth 2013: 508) Leon Fuerth (2013) focuses on how fracking includes the danger of "severe water contamination," storage of CO_2 in geological formations comes at the risk of unknown consequences, and that "self-policing" in the fracking industry is "a sham." (Fuerth 2013: 510) Due to these and other concerns, Fuerth posits that "climate change has become a national security priority on par with ensuring access to energy." (Fuerth 2013: 503)

Chapter Two outlines the efforts of the international community to address the environmental impacts of these challenges with global environmental protocols.

I.C.

Development

The global environmental accords explored in Chapter Two focus on limiting or rectifying environmental degradation (chiefly, GHG emissions) through funding and technology transfers for the clean and sustainable development of industrializing countries, guided by the concept of *common but differentiated responsibilities* – the obligation of developed countries to assume the majority of the responsibility for historical greenhouse gas emissions. To this end, a number of international initiatives and mechanisms have risen, such as the following:

- Multilateral Fund
- Global Environment Facility (GEF)
- Clean Development Mechanism (CDM)
- Technology Executive Committee
- Climate Technology Centre and Network
- Green Climate Fund
- Expert Group on Technology Transfer 2010
- UNFCCC Climate Finance Network
- EU Emissions Trading Scheme (EU ETS)

Chapter Three focuses on the Clean Development Mechanism (CDM) in particular, to trace the international community's development goals of lowered emissions (in particular, CO_2 emissions) through technology transfer and funding, as set forth in the global protocols covered in Chapter Two.

Outside of the efforts of the international environmental community, states have achieved mixed results in development. Reid and Goldemberg (1998) trace the efforts of Mexico and India at clean development after the Kyoto Protocol. India invested in subsidies for wind turbines as well as running a Five-Year Plan which included a National Energy Efficiency Programme; Mexico established a National Commission for Energy Conservation. (Reid and Goldemberg 1998: 235)

Alongside these efforts, however, the authors acknowledge that developing countries face health problems from air pollution due to fossil fuel use, with the economic damages from health problems solely due to air pollution estimated at $1.5 billion USD per year. (Reid and Goldemberg 1998: 236) Furthermore, the role of the developed world is hardly clear:

> "All parties to the Climate Convention, including developing countries, have already committed to 'promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce, or prevent anthropogenic emissions of greenhouse gases....' Policy changes and conservation and renewable energy programs in developing countries are already leading to significant carbon emission savings; new policies should seek to assist further in these efforts. Economically attractive options to increase energy efficiency in developing countries are more widespread than in the OECD countries. However, given the fact that developing countries are aggressively pursuing these options, while OECD countries will fail to meet their voluntary targets, one questions whether industrialized countries are leaders or laggards in mitigating climate change."
>
> (Reid and Goldemberg 1998: 237)

With so much uncertainty over who owes what, who is responsible for what, and who will do what, this essay seeks to outline the goals established by the international community to address environmental degradation, to analyze these proposed goals with a closer look at the Clean Development Mechanism (CDM), and to highlight some promising endeavors which can support these international efforts.

I.D.

Methodology and Research Question; Structure of Essay

Taking into consideration the principle of *common but differentiated responsibilities*, this essay follows the goals established for GHG emissions reductions as well as for funding and technology transfers towards clean and sustainable development. The essay considers thirty years (1987-2017) and five global environmental protocols to establish whether a gap exists between the **intent** and the **execution** of the goals set by the international community.

The essay proceeds under the following research question: Has the international environmental community executed the intentions outlined in the past thirty years of agreements, or is there a gap between policy and implementation of the global environmental protocols – *an environmental paradigm gap*? What were the goals of the environmental protocols, in comparison to what they have achieved?

Chapter Two provides a summary of the following five global environmental protocols, following the evolution of the basic principles and expectations cemented by the international community:

- The Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Rio Declaration on Environment and Development (1992)
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997)
- Copenhagen Accord (2009)
- Paris Agreement (2015)

Thirty years of such internationally agreed-upon environmental protocols have set the bar of expectations on environmental action; these agreements provide the framework of the global response to global environmental degradation. Other notable conferences have contributed to the international environmental discussion (such as the Stockholm Conference of 1972), but this essay focuses on the past three decades as the bookends for its sample.

Chapter Three hones in on the Clean Development Mechanism (CDM) and its contribution to financing and technology transfers aimed at reducing GHG emissions. Through an analysis of the CDM in particular (established in the Kyoto Protocol), the essay investigates the question of whether an environmental paradigm gap exists between the intent of the mechanism and its execution. Future research could replicate this methodology and apply this research question to any of the mechanisms mentioned in Section I.C, such as the Green Climate Fund, the Multilateral Fund, et cetera.

Chapter Four outlines the dangers of methane emissions and its relation to organic waste and the waste management sector. The chapter mentions a few positive initiatives for mitigating these emissions, such as composting projects under the CDM. The chapter also offers policy recommendations.

Chapter Five contains the conclusion, a summary the findings of the essay.

II.

A Narrative of Five Global Protocols

Global indicators of environmental degradation have pushed states to negotiate, agree upon, and either sign or recognize noteworthy global environmental protocols. States enter into these agreements for reasons of security and development, and to establish moral high ground as Parties to the agreements, which are binding to varying degrees yet essentially voluntary.

Global Indicators of Environmental Degradation:

- Arctic ice melt (resulting in competition over extractive rights);
- Rising sea levels (causing migration and international security concerns);
- Ocean acidification (followed by coral reef deaths, loss of species and biodiversity);
- Pollution in cities (requiring citizens to wear masks due to poor air quality);
- Extreme weather incidents such as droughts, floods, high-intensity storms (endangers global security and global energy security); and
- Deforestation

The past thirty years of international cooperation to address global environmental degradation, starting in Montreal in 1987, sought a framework for the global approach to addressing global environmental degradation, and for conceptualizing a united response. Convening under a platform provided by the United Nations, these meetings serve as the action of the global community as a response to an uncertain and possibly bleak future.

Across these five protocols, the recurring goals of GHG emissions reductions, and funding and technology transfers from industrialized countries to industrial countries, serve as variables for identifying the existence or absence of a gap between the intent and execution of the goals of the protocols.

II.A

Montreal Protocol on Substances that Deplete the Ozone Layer (1987)

The first United Nations-led conference on climate change in the past thirty years, The Montreal Protocol on Substances that Deplete the Ozone Layer (1987), entered into force on 1 January 1989. (UNEP Montreal Protocol 2000: 39) The main theme emerging from this protocol, a list of controlled substances, spans Annexes A through C and bans 96 substances mainly found in air conditioning or refrigeration units, fire extinguishers, and aerosol products. (UNEP Montreal Protocol 2000: 46)

The Montreal Protocol also (through control of trade and non-export of technology) provisioned against sending any technology regarding production of these banned substances to non-Parties to the agreement. (UNEP Montreal Protocol 2000: 24) Article 8, however, formally recognized the lack of a solution for addressing non-compliance. (UNEP Montreal Protocol 2000: 32)

Article 10 of the Montreal Protocol outlined the Financial Mechanism of the protocol, including Article 10A "Transfer of Technology," which aimed to ensure that "the best available, environmentally safe substitutes and related technologies are expeditiously transferred" and that these "occur under fair and most favourable conditions." (UNEP Montreal Protocol 2000: 36) This early iteration of the funding and technology transfer theme remained vague and simply served to introduce the expectation; successive protocols continued to develop and specify these requirements.

Velders et al. (2007) noted that "≈80% of ODSs [Ozone-Depleting Substances] that would be used today without the Montreal Protocol have been successfully phased out without the use of other fluorocarbons. Instead, this ODS use was eliminated with a combination of 'not-in-kind' chemical substitutes, product alternatives, manufacturing-process changes, conservation, and doing without." (Velders et al. 2007) Evidence such as this contributes to the widespread belief of the effectiveness of the protocol. The authors continued by summarizing the accomplishments realized under the agreement:

> "The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer formally recognized the significant threat of the ODSs to the ozone layer and provided a mechanism to reduce and phase-out the global production and consumption of ODSs. Under the Montreal Protocol and national regulations, significant decreases have occurred in the production, use, emissions, and observed atmospheric concentrations of CFC-11, CFC-113, methyl chloroform, and several other ODSs and there is emerging evidence for recovery of stratospheric ozone. In a 'world avoided' that lacks the early warning in 1974 and the Montreal Protocol of 1987, depletion of the ozone layer likely would be much greater than observed in our world today."
>
> (Velders et al. 2007)

In part due to the momentum achieved in Montreal, thirty years' worth of global agreements seeking to match the effectiveness of the Montreal Protocol have followed. Each successive agreement has considered the concept of *common but differentiated responsibilities* in order to promote cooperation between the global North and the global South and to account for varying degrees of culpability for historical emissions. As noted by Eckersley (2012), "it was not until the Montreal Protocol 1987 that the regulative ideals of differentiated responsibilities began to take a clearer and more practical shape;" this included "Southern participation in return for Northern assistance," or a bargain in which "this obligation is derived from their significant historical and current emissions, their high per capita emission and their greater capabilities (technological, economic and administrative) to pursue mitigation and assist developing countries with mitigation and adaptation." (Eckersley 2012: 30)

Five years later, the Rio Earth Summit expanded on these ideals.

II.B.

Rio Declaration on Environment and Development (1992), produced at the Rio Earth Summit

During the Rio Earth Summit of 1992, the concept of *common but differentiated responsibilities* emerged in detail. According to the *Earth Summit: Rio Report Card* (Tollefson and Gilbert, 2012), and despite diplomats from the 178 nations that attended the Rio summit having "spent the previous two years drafting a pair of treaties intended to safeguard Earth's biodiversity and climate," international agreement had always faded in years prior to the summit in the struggle to reach agreeable solutions or compromises on biodiversity and climate issues, because "rich and poor countries split over who should pay for protecting the planet." (Tollefson and Gilbert 2012: 20)

To address this difficulty, Principle 7 of the Rio Declaration defined *common but differentiated responsibilities* – that for states to cooperate in a successful global partnership, developed countries have heightened obligations due to their advanced technologies, financial resources, and historical culpability. One hundred ninety-four countries (and the European Commission) ratified the Declaration, signifying an acceptance of this landmark concept, and the Rio Declaration on the whole "sought to stabilize emissions at a level that would 'prevent dangerous anthropogenic interference with the climate system.' Although there were no specific targets, wealthy countries agreed to take the lead and help poor countries with monetary and technological aid." (Tollefson and Gilbert 2012: 21)

Other aspects of the Rio Declaration have proven more problematic. While the Declaration urged states to "enact effective environmental legislation" (UN Rio Declaration 1999: Principle 11) and suggested that states develop national law to compensate victims, (UN Rio Declaration 1999: Principle 1) it nevertheless acknowledged that states have sovereign rights over their own resources and resource exploitation according to their own environmental and developmental policies. (UN Rio Declaration 1999: Principle 2) These realities allow states to define the meaning of *development* in their own interests and to use the concept as an excuse for business-as-usual environmental degradation even though Principle 25 noted the relationship of "peace, development and environmental protection."

Twenty-five years after the Rio Declaration, certain trends stand out. In spite of language linking development with environmental protection in order to halt climate change,

> "The world pumped 22.7 billion tonnes of carbon dioxide into the atmosphere in 1990, the baseline year under the UN Framework Convention on Climate Change. By 2010 that amount had increased roughly 45% to 33 billion tonnes. Carbon dioxide emissions skyrocketed by more than 5% in 2010 alone, marking the fastest growth in more than two decades as the global economy recovered from its slump. And despite constant deliberations under the convention, the overall growth rate of global emissions hasn't changed much since 1970 (see 'Report card: UN Framework Convention on Climate Change')."
>
> (Tollefson and Gilbert 2012: 21)

Despite the international efforts at goal-setting, neither developed nor developing countries have radically altered the track of industrialization to include clean and sustainable development habits. On the contrary, "the United States, the developed world's largest greenhouse-gas producer, never ratified the protocol and increased its greenhouse-gas output by 11% between 1990 and 2010. In the meantime, developing countries more than doubled their emissions, increasing their share of the global total from 29% to 54%." (Tollefson and Gilbert 2012: 21)

Principle 12 advised states to cooperate "to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation," essentially to hammer out their differences and obligations under *common but differentiated responsibilities*. However, with ever-rising emissions and ever-increasing environmental degradation, the question remained after the Rio Declaration and its aftermath.

In spite of the agreement of wealthier countries to provide funding and technology to address their commitments in light of the concept of differentiated responsibilities, "on the core challenge of overhauling the global energy industry and reducing emissions, the questions remain the same 20 years later: who must do what and who pays?" (Tollefson and Gilbert 2012: 21) The Rio Declaration offered the first steps towards solving these questions, yet remained vague enough to necessitate the articulation of clearer goals.

II.C.

Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997)

Five years after the Rio Earth Summit, the discourse surrounding funding, clean technology transfers, and sustainable development had grown clearer. Article 3, Point 14 of the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change delved into how to "minimize the adverse effects of climate change" by considering "the establishment of funding, insurance and transfer of technology." (UNFCCC Kyoto Protocol 1998: 5)

Annex A specified the six main GHGs – Carbon dioxide ($C0_2$), Methane (CH_4), Nitrous oxide (N_20), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF6) – and the main sectors in which to target these substances (Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, and Waste). (UNFCCC Kyoto Protocol 1998: 19) Article 11, Points 2a and 2b reinforce that developed country Parties should provide financial resources and technology transfers to ensure that developing country Parties consistently meet the emissions reduction commitments outlined in Annex B. (UNFCCC Kyoto Protocol 1998: 10) However, in terms of emissions reductions, the Protocol only targeted developed nations, as developing nations remained free to close the historical gap and continue their industrialization.

In addition to the Annexes, the proposal of the Clean Development Mechanism (CDM) (UNFCCC Kyoto Protocol 1998: 11) – a tour de force of the Kyoto Protocol – laid the framework to provide funding and technology transfers for *green development*, especially in the Least Developed Countries (LDCs), Small Island Developing States (SIDS), and those most vulnerable. The CDM, discussed in depth in Chapter Three, built upon the vague language of the Rio Declaration in terms of funding and technology transfers to stabilize GHG emissions. Projects under this mechanism, for instance, could reduce GHG emissions or increase *sinks* (which pull GHG from the atmosphere), a common example of which is newly created forests.

Post-Kyoto, analysis of the Protocol's shortcomings began. No matter the metric, the fact that GHG emissions reductions applied solely to developed countries limited the potential effectiveness of GHG reductions as proposed in Annex B. The Protocol "involves a 'basket of greenhouse gases'" and thus a country may "reach its target by combining emissions reductions for a range of gases in some CO_2-equivalent sense," where "'CO_2-equivalence' … is not rigorously defined;" (Wigley 1998: 2285) nevertheless, the developing world produces the largest growth in new emissions, limiting the effectiveness of the measures of the agreement.

In fact, as analyzed by Rosen (2015), “with the Intergovernmental Panel on Climate Change (IPCC) now claiming that some climate change is unavoidable and irreversible (IPCC 2014), it is clear that the Kyoto Protocol has failed in its primary mission: to reduce the amount of GHGs entering the atmosphere.” (Rosen 2015: 34) In line with the concept of differentiated responsibilities, the Kyoto Protocol set the framework of emissions cuts in developed countries, in the hopes of addressing “the high rates of GHG emissions into the atmosphere and the resulting likelihood of severe climate change.” (Rosen 2015: 38) Even with this framework,

> “globally, emissions did not decline or stay stagnant compared to the 1990 baseline year; instead, they dramatically increased. In 1990, the global output of carbon dioxide was 22.7 billion tons; in 2008 it was 31.7 billion and in 2013 it was 36 billion (Le Quere 2014). That represents an increase of 59 percent between 1990 and 2013, and an increase of approximately 14 percent over the course of the first Kyoto commitment period. Prospects for avoiding a 2 degrees Celsius temperature increase—considered essential to avoid the worst effects of climate change—are grim (UNEP 2012).”
> (Rosen 2015: 38)

The international community could not meet GHG reductions limits due to large emissions growth increases in the developed world. On top of this, the results from the developed countries in terms of emissions reductions reveal mixed levels of success. Canadian CO_2 emissions between 1990 and 2012 increased 25 percent; Japan’s, 14 percent; and although the European Union reduced emissions levels 15 percent after 1990, due to a “burden-sharing arrangement … only eight of the 15 countries were reported to have met their individual targets—Finland, France, Germany, Greece, Ireland, Portugal, Sweden, and the United Kingdom.” (Rosen 2015: 36)

Houser (2010) pointed out two main shortcomings with the Protocol: first, these “mitigation shortcomings are compounded by the fact that the largest Annex I emitter, the United States, is not a party;” second, although the emissions reductions by developed countries “accounted for 60 percent of global GHG emissions when the UNFCCC was signed in 1992 (50 percent if emissions from land-use change are included), they will account for only 3 percent of the global growth in emissions going forward (figure 1).” (Houser 2010: 2)

Due to these issues, the Kyoto Protocol has faced heavy criticism since its adoption. Although its goals were never fully implemented – for example, developed countries never met their emissions requirements, and Canada pulled out of the Protocol before receiving sanctions – even imagining full implementation, the Protocol did not accurately provide for notable emissions reductions.

Furthermore, as summarized by Houser, “the Kyoto Protocol provides only limited resources to help developing countries reduce emissions, and provides almost nothing to help vulnerable countries adapt to climate change … with only developed countries required to reduce emissions, the Kyoto Protocol falls far short of the global emission reductions needed to protect vulnerable countries from the consequences of a world that is greater than 2 degrees Celsius warmer than preindustrial levels.” (Houser 2010: 8) Over a decade later in Copenhagen, the international community attempted to shore up these deficiencies.

II.D.

Copenhagen Accord (2009), produced at the Copenhagen Climate Change Summit

In the run-up to the 2009 Copenhagen conference, most actors in the global environmental web recognized the need to extend the burden of emissions reductions to emerging countries like the BRICS (Brazil, Russia, India, China, South Africa) – with a special focus on China, India and Brazil – for any hope of meeting the two degrees Celsius cap.

Point One of the Copenhagen Accord reaffirmed the argument of *common but differentiated responsibilities* in outlining the general goals of combatting climate change

(UNFCCC Copenhagen Accord 2009: 1) in the quest of stabilizing GHG concentration in the atmosphere below 2°C. Along these lines, Point Two covered a triplet of topics regarding emissions: "deep cuts in global emissions;" peak global and national emissions; and the statement that "a low-emission development strategy is indispensable to sustainable development." (UNFCCC Copenhagen Accord 2009: 2)

The Accord also covered financing and technology transfers, asserting in Point Three that developed countries should provide this. (UNFCCC Copenhagen Accord 2009: 2) Point 8 calls for "scaled up, new and additional, predictable and adequate funding as well as improved access;" "substantial finance to reduce emissions from deforestation and forest degradation (REDD-plus), adaptation, technology development and transfer and capacity-building;" and the establishment of the Copenhagen Green Climate Fund (GCF), in support of which "developed countries commit to a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries." (UNFCCC Copenhagen Accord 2009: 3)

In short, the Copenhagen Accord continued and expanded upon the themes of GHG emissions stabilization, financing, and transfer of technology; the Accord also re-iterated the *differentiated responsibilities* concept in terms of these issues. As summarized by Levi (2013),

> "the Copenhagen Accord had four critical elements: (a) agreement to aim to keep global temperature increases below 2°C; (b) emissions-cutting commitments from developed and developing countries [...]; (c) a commitment by developed countries to contribute $30 billion to assist developing countries by 2012 and to raise up to $100 billion annually for the same purpose by 2010; and (d) an agreement from all to develop a process of 'consultation and analysis' that would review countries' mitigation efforts."
>
> (Levi 2013: 492)

However, the Accord faced major obstacles. In contrast to the Kyoto Protocol, which placed binding emissions reduction requirements only on developed countries, the Copenhagen Accord extended these requirements to all nations, yet stumbled on the question of which metric would measure emissions.

Prior to the Copenhagen Climate Change Summit, for example, China "announced a commitment to reduce the emissions intensity of GDP in 2020 by 40 to 45 percent compared with the level in 2051. The decision to target emissions intensity measured by GDP, rather than the level of emissions, is believed to support China's position regarding responsibility and hence culpability for historical CO_2 emissions and its position that action on climate change should not unfairly limit growth in developing countries." (Lu et al. 2013: 2) Developed countries, on the other hand, "continued to specify their emissions reduction targets in terms of the level of emissions," (Lu et al. 2013: 4) preferring in the case of China, India and other large emitters to shy away from the measurement of emissions based on GDP and per-capita figures due to high population numbers coupled with lower earnings.

In addition to the problem of measuring emissions, the Accord also sparked controversy due to the fact that "the regular negotiations were suspended on the last day of the conference while a 25 member Friends of the Chair group met to craft a short compromise text to replace the 200-plus pages of text that had been negotiated over two years. Violations in normal procedures, including lack of transparency and inclusivity, were cited as some of the reasons why some states, such as Bolivia, refused to give their support to the Accord." (Eckersley 2012: 37) Many actors (such as the European Union, which did not help craft the final document) considered this process a collaboration of the powerful nations behind closed doors; as a result, "the Accord was merely noted rather than formally endorsed by COP15 due to formal objections by a small group of countries (led by Sudan, Venezuela and Bolivia) that the document was illegitimate because the usual procedures for consultation, plenary debate and discussion were not followed." (Eckersley 2012: 31)

Finally, although the Copenhagen Accord "calls for the establishment of a 'Copenhagen Green Climate Fund' to support mitigation, adaptation, and technology cooperation;" although "developed countries pledged a combined $30 billion between 2010 and 2012 and $100 billion per year by 2020;" and although "the poorest and most vulnerable developing countries will have priority in receiving financial assistance;" (Houser 2010: 14) since the Parties merely noted rather than signed and ratified the Accord, these measures remain fully optional.

With a view towards cementing these obligations in legally-binding form, the international community once again met with much fanfare six years later in Paris.

II.E.

Paris Agreement (2015)

The 2015 global agreement to address environmental degradation – the Paris Agreement – targeted CO_2 emissions (as well as clean and sustainable development) through finance and technology transfer, in addition to addressing *capacity-building*. The agreement also re-stated the aim of a collective mobilization by developed countries of $100 billion USD per year, for "needs and priorities" of developing countries. (UNFCCC Paris Agreement 2015: 5) The principles of *equity, respective capabilities of states,* and *common but differentiated responsibilities* guided the Paris Agreement towards the goals of holding global atmospheric temperatures below 2°C, and providing finance flows for clean development and low GHG emissions.

The Paris Accords also suggested areas for further research going forward. The first suggestion – an *Ad Hoc Working Group on the Paris Agreement*, (UNFCCC Paris Agreement 2015: 5) with the goal to offer guidance for accounting for *nationally determined contributions* –

would establish two norms, that *anthropogenic emissions/removals accounting* would utilize IPCC methodologies and metrics, and that accounting would include all categories of emissions/removals in nationally determined contributions. (UNFCCC Paris Agreement 2015: 5) The second suggestion calls for research on a framework for non-market approaches to sustainable development, and to "enhance linkages and create synergy between" (UNFCCC Paris Agreement 2015: 6) mitigation, adaptation, finance, technology transfers, and capacity-building. (UNFCCC Paris Agreement 2015: 6)

The agreement recognizes on top of this that despite efforts and frameworks towards intended nationally determined contributions of parties, the aggregate greenhouse gas emissions levels of these will nevertheless far exceed 2°C, and that "greater emission reduction efforts" are required; (UNFCCC Paris Agreement 2015: 3) this mirrors Point Two of the Copenhagen Accord. Mitigation of GHG and support for sustainable development can buoy these efforts.

In addition to these basic considerations, the Paris Agreement addresses CO_2 emissions by calling for global peaking of GHG emissions as soon as possible. (UNFCCC Paris Agreement 2015: 22) The Agreement specifies financing and technology transfer by creating a framework for a *Financial Mechanism* and a *Technology Mechanism*. The Financial Mechanism of the convention includes the Green Climate Fund (GCF) and the Global Environment Facility (GEF). The GEF supports and operates the Least Developed Countries Fund and the Special Climate Change Fund. (UNFCCC Paris Agreement 2015: 26)

Financially, these initiatives depend upon developed country Parties to provide financial resources, known as *climate finance*, "beyond previous efforts." (UNFCCC Paris Agreement 2015: 26) With regards to technology transfer, the convention seeks to launch a technology examination process on adaptation within the years 2016-2020. Along these lines, under the

Paris Accords the Parties agree to conduct technology needs assessments (focusing on socially and environmentally sound technology) to both establish a technology framework (the Technology Mechanism) and assess technology currently ready for transfer. (UNFCCC Paris Agreement 2015: 27)

Vandyck et al. (2016) summarized the Paris Agreement in the following manner:

> "The Paris Agreement is an important step forward in international climate change negotiations. Its main merits include a legally binding 2°C target, the introduction of a five-yearly review process from 2018 onwards with a first global stocktake scheduled for 2023 and an agreement on international climate financing. Compared to previous editions such as COP3 in Kyoto and COP15 in Copenhagen, the bottom-up approach to climate change mitigation (introduced in Durban, COP17 in 2011) was a fundamental shift in the nature of the policy process."
>
> (Vandyck et al. 2016: 46)

Although too little time has passed to accurately judge the Agreement, the quote hints at the air of positivity around the Paris Agreement. At least in terms of goal-setting, the Agreement seems to offer progress in its affirmation of the $100 billion USD annual allocation and the intentions to establish Technology and Financial Mechanisms.

III.

Is There a Gap Between Policy and Implementation of the Goals of the Five Global Protocols? The Case of the CDM

Has the international community succeeded in implementing the policies articulated in the global environmental protocols contained in Chapter Two, or does a gap exist between intent and execution? To answer this question, this chapter focuses in particular on the Clean Development Mechanism (CDM) as proposed in the Kyoto Protocol, which conceptualized the mechanism through the following definition: "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention." (UNFCCC Kyoto Protocol 1998: 11)

Schneider et al. (2008) outlined the CDM as a "market-based mechanism aimed at triggering changes in the pattern of emission-intensive activities in developing countries," (Schneider et al. 2008: 2930) in part by providing incentives for funding of projects (and thus technology transfer) to the private sector. Private-sector technology transfer commonly takes three forms: Foreign Direct Investment (FDI), trade, and licensing. (Schneider et al. 2008: 2931)

Many barriers to technology transfer exist, however, and contribute to the gap between the policy (technology transfer and funding as ideas) and its implementation (technology transfer and funding in reality). First and foremost, a project could lack commercial viability, lack capital or access to funds, or attempt to operate in a politically volatile system or region. Additionally, "technology providers have limited interest in the diffusion of their technology into the local economy because they hope to avoid imitation." (Schneider et al. 2008: 2931)

Technology transfers occur more commonly with long-term projects like FDI, (Schneider et al. 2008: 2932) which can not only bring in new equipment and processes but also improve the capacity and knowledge of local workers and communities. In addition, these transfers frequently happen more "for projects that involve foreign participants than for unilateral projects," (Seres et al. 2009: 4924) which inspires change and innovation.

Although a host country can "influence the extent of technology transfer involved in its CDM projects through the criteria it establishes for approval of CDM projects," (Seres et al. 2009: 4924) transfers do not occur for all CDM projects. Seres et al. (2009) provide details on projects under the CDM and their corresponding technology transfers: out of 856 hydro projects, 8% involved technology transfers; out of 524 biomass energy projects, only 22%; 419 wind projects, only 48%; 265 landfill gas projects, 67%. (Seres et al. 2009: 4921) Schneider et al. (2008) report similar data, on a country-by-country basis: Mexico, China and Brazil featured the most projects with transfers of technology (142, 195, and 72 projects respectively), yet the percentage of technology transfers falls short of full capacity (94%, 49%, and 33% respectively). (Schneider et al. 2008: 2935)

These countries, with the addition of India, represent another inefficiency of the CDM process, that they receive the bulk of CDM attention and that the mechanism thus concentrates the dispersal of its projects. As explained by Gaast et al. (2009):

> "CDM projects are largely concentrated in a few developing countries. Asia and the Pacific have 1860 projects in the CDM pipeline (72% of all), Latin America has 601 projects (24%), North Africa and the Middle-East have 34 projects (1.5%), Sub-Sahara Africa has 33 projects (1.5%), and Non-Annex I Europe and Central Asia have 23 projects (1%) (as of October 2007). For each region, the dominance of one or two countries is clear: China and India dominate the Asian region; Brazil and Mexico have most projects in Latin America; Armenia and Moldova host most projects in the European/Central Asian region; and in the Middle-East and African regions Israel and South Africa dominate. According to the Nairobi Framework, which was adopted by the second meeting of the Kyoto Protocol Parties (COP-MOP-2), held in Nairobi, Kenya, in November 2006, the main challenge for the CDM is to achieve a more equal distribution of projects across countries, in particular least developed countries."
>
> (Gaast et al. 2009: 231)

These facts further support the notion of a gap between policy and implementation of the goals of the global protocols, as the protocols specifically mentioned the Least Developed Countries (LDCs) and Small Island Developing States (SIDS) as the main targets of funding and technology transfer efforts.

The CDM itself "is a project based mechanism which allows for implementation of greenhouse gas emissions reduction projects in developing countries." (Lema and Lema 2013: 303) However, as shown by Lema and Lema (2013) in their analysis of wind technology transfers under the CDM,

> "important technology transfer mechanisms such as foreign subsidiaries, joint ventures or license arrangements materialise in conjunction with local capacity to produce and develop wind power equipment. In other words, transfer mechanisms seem to co-evolve with domestic capabilities. Rather than becoming less likely, technology transfer changes in nature as domestic capabilities increase."
>
> (Lema and Lema 2013: 303)

In other words, although the CDM helps generate momentum towards positive advancements in GHG emissions reductions through funding and transfers of technology, the degree to which these developments occur directly due to the CDM remains a question. CDM projects operate hand-in-hand with and rely upon local capabilities. Nevertheless, since “greenhouse gas emissions in developing countries are expected to account for up to 70% of the global increase in emissions in the period 2002–2030,” all such projects aimed at GHG emissions stabilization remain relevant, and the CDM maintains its status “as one of the most important vehicles for the transfer of low carbon technology and know-how between developed and developing countries.” (Lema and Lema 2013: 301)

In light of this, what kinds of projects under the CDM show the most promise? Certainly, “technologies like renewable energy and energy-efficiency projects require the improvement of local skills and the diffusion of technical knowledge into the local economy and, consequently, thereby contribute much more to a recipient country’s know-how,” (Schneider et al. 2008: 2936) as seen in the explosion of wind technology in China and India, which have become world leaders in turbine production. In addition, as “the Intergovernmental Panel on Climate Change (IPCC) considers waste as one of the seven key sectors contributing to climate change (IPCC, 2007),” (Rogger et al. 2011: 138) the next section takes a closer look at improved waste management techniques as a key and underutilized area for CDM projects.

Since the CDM as analyzed in this section exhibits signs of an environmental paradigm gap between the policy and its execution – mainly in that technology transfers do not always occur, funding is tied to market-based incentives and the private sector, CDM projects mainly occur in a few main regions and countries, technology providers resist disseminating their capabilities, and successes may depend on factors other than the CDM such as local capacity –

what are some positive developments and some areas for improvements going forward in attempting to fill this gap, and implement more, and more effective, GHG reduction projects?

IV.

Ways forward? Policy Recommendations

IV.A.

Waste Management and Its Contribution to GHG Emissions

As evidenced by Annex A of the Kyoto Protocol, which identified waste as one of the main sectors relevant to GHG emissions, (see Chapter Two) the international community recognizes the contribution of waste management to GHG concentrations in the atmosphere. (UNFCCC Kyoto Protocol 1998: 19) Waste management generally consists of three categories – organic material, recyclable material, and discardable material destined for landfills.

As noted by the World Bank (2012), "Organic waste comprises the majority of MSW, followed by paper, metal, other wastes, plastic, and glass;" as of 2009, organic waste made up 62% of the Municipal Solid Waste (MSW) stream in East Asia and the Pacific Region, and 27% in the OECD countries. (Hoornweg and Bhada-Tata 2012: 18) The report notes that "post-consumer waste is estimated to account for almost 5% (1,460 mtCO_2e) of total global greenhouse gas emissions," and offered as a solution that "encouraging waste minimization through MSW programs can therefore have significant upstream GHG minimization benefits." (Hoornweg and Bhada-Tata 2012: 29)

On top of this, "methane from landfills represents 12% of total global methane emissions;" although it can be captured and used as energy, the gas, "which has a Global

Warming Potential 21 times greater than carbon dioxide, is the second most common greenhouse gas after carbon dioxide." (Hoornweg and Bhada-Tata 2012: 30) These figures represent an opportunity for GHG emissions mitigation. The World Bank report suggests composting "the organic material after digestion to produce a useful soil conditioner and avoid landfill disposal," because "finished compost applied to soils is also an important method to reduce GHG emissions by reducing nitrogen requirements and associated GHG emissions." (Hoornweg and Bhada-Tata 2012: 31)

Howarth et al. (2012) reach similar conclusions about methane, "the second largest contributor to human-caused global warming after carbon dioxide." (Howarth et al. 2012: 1) The authors discuss the thawing of permafrost due to global warming, which "may trigger a large and rapid increase in the release of methane from the arctic," (Howarth et al. 2012: 1) which would create a downward spiral of ever-increasing warming trends, which would cause more permafrost thawing in a positive feedback loop. NASA and the Goddard Space Flight Center (2005) also state that "the true source of some of the warming that is normally attributed to tropospheric ozone is really due to methane that leads to increased abundance of tropospheric ozone […] the effects of other pollutants were relatively minor." (NASA 2005)

With methane thus identified as more powerful (though less abundant in the atmosphere) than CO_2, the global community clearly must add to the urgency of its methane mitigation efforts on a similar scale as its efforts to stabilize carbon dioxide emissions. Improved efficiency in the waste management sector – a leading cause of methane emissions – provides a platform for at least slight reductions in methane levels.

First and foremost, as noted by the IPCC in 2007, "Recycling, re-use and waste minimization initiatives, both public and private, are indirectly reducing GHG emissions by decreasing the mass of waste requiring disposal." In addition, waste scavengers and trash pickers can effectively minimize the mass of waste destined for the landfill through reclamation, while simultaneously creating a mode of employment. (IPCC *Mitigation* 2007: 72) In terms of the waste management sector and its overall potential for contributing to GHG emissions mitigation, the IPCC report notes:

> "Existing waste management technologies can effectively mitigate GHG emissions from this sector – a wide range of mature, low- to high-technology, environmentally- effective strategies are commercially available to mitigate emissions and provide co-benefits for improved public health and safety, soil protection, pollution prevention and local energy supply. Collectively, these technologies can directly reduce GHG emissions (through landfill CH4 recovery and utilization, improved landfill practices, engineered wastewater management, utilization of anaerobic digester biogas) or avoid significant GHG generation (through controlled composting of organic waste, state-of-the-art incineration, expanded sanitation coverage).
>
> (IPCC *Mitigation* 2007: 73)

In addition, in 2007 the waste sector contributed 2.8% of global anthropogenic GHG emissions, (Rogger et al. 2011: 139) not an insignificant portion.

With this information in mind, the individual can help buoy the efforts of the global institutions and the states contained in the global environmental protocols by improving waste management practices through composting, recycling, and greater conservation and efficiency endeavors. In these ways, the individual can become an actor in efforts to limit GHG emissions.

Rogger et al. (2011) look at two types of GHG reduction projects for landfills under the CDM: composting projects and landfill gas projects (*aeration*), both of which could replace open dumping in developing countries with landfills which prevent methane generation. (Rogger et al. 2011: 138) While studies show aeration to reduce GHG emissions, composting outperforms other projects for the following reasons:

- lowers water content in landfills, reducing toxic leakage which potentially contaminates neighborhoods; improves soil fertility by reducing erosion, restoring degraded soil, fertilizing, controlling plant diseases, increasing water-holding capacity; contributes to carbon sequestration (Rogger et al. 2011: 143)

The authors found, however, that not only does the CDM prioritize the more technological-based landfill gas projects – these enjoy "high investment attractiveness in comparison to composting projects" (Rogger et al. 2011: 140) because composting projects pay off more slowly over the long run – but that due to this, composting projects may even face *financial disincentivization*. (Rogger et al. 2011: 145) This provides even more incentive for the individual to engage in conservation practices such as composting, to close the gap between the goal of minimizing environmental degradation and the inefficiencies of the implementation of solutions by the international community on a global scale.

After all, soils act as a powerful *carbon sink*, which the application of organic soil improvers such as compost or manure only enhances; (Favoino and Hogg 2008: 150) furthermore, soils hold twice as much carbon as vegetation. (Favoino and Hogg 2008: 145) Organic amendments increase the quality of the structure of soil, which leaves a higher proportion of nutrients available for plants, unlike with fertilizer usage, (Favoino and Hogg 2008: 152) which contributes to GHG emissions, chiefly in the form of nitrous oxide. (Favoino and Hogg 2008: 153)

Along these lines, Favoino and Hogg (2008) explain the *positive externalities*, or positive side effects, of compost application: less fertilizer and pesticide usage, avoiding GHG emissions associated with production; improved tilth and workability of soil, requiring less GHG emission in the form of fuel consumption; and reduced irrigation requirements, increasing the retention rate of soil moisture. (Favoino and Hogg 2008: 146) These factors, according to the authors, have informed European Union policy-making regarding the issues of infertile soil, a decline in soil organic matter, and an abundance of landfilled biodegradable municipal waste. (Favoino and Hogg 2008: 147)

The developing world also remains cognizant of these issues. In China, for example, despite a history of composting stretching as far back as the year 1149, the practice has recently “decreased sharply” with the “development of conventional farming.” (Li et al. 2008: 163) According to Li et al. (2008), organic solid waste and its treatment has become a major environmental threat in the country due to “the pollution on waterbodies from those agricultural activities.” (Li et al. 2008: 163) A study of India found a 67% increase in Municipal Solid Waste (MSW) generation for a population increase of only 49%, and that “with waste streams comprised of 55% or greater organic matter in developing countries, composting is being considered in many parts of the world (especially in the tourist and agricultural sectors) as a method to reduce waste destined for the landfill.” (Troschinetz and Mihelcic 2009: 915)

Given the correlations between greater affluence and greater MSW production, and higher percentages of MSW generation than increases in population, the question of how to reduce both MSW and organic matter in the MSW stream takes on great importance. Troschinetz and Mihelcic (2009) report on the potential beneficial influence of scavengers – “citizens with low- to no-income that collect materials either dispersed throughout the city or concentrated at dumpsites” – on sustainable development, which could result in systemic improvements in MSW management in the developing world while also reducing poverty and pollution, creating jobs, conserving resources, and protecting the environment. (Troschinetz and Mihelcic 2009: 919)

Support and incentivization for the informal waste management sector could thus offer a model for job creation, efficiency in resource usage, and environmental stewardship. The informal recycling sector, for example, identifies *potential value* “by sorting, cleaning, altering the physical shape” until recovered materials become “a commercially viable quantity;” organic waste, for example, can transform into “livestock fodder, soil improvers and fuel.” (Wilson et al. 2006: 801) Unfortunately, as Wilson et al. (2006) report, “Western countries allowed their earlier informal recycling systems to disappear, and have struggled over the last 10 years to re-establish more formal systems to rebuild recycling percentages to former levels.” (Wilson et al. 2006: 802) A re-emphasis on these systems could preserve landfill space, reduce waste collection costs, and maximize the efficiency of consumption.

This type of re-orientation has precedent even in the developed world and could provide the blueprint for a model for financing green initatives. Gerig (2008) recounts the story of Nordostschweizerische Kraftwerke (NOK), a major electricity company in Switzerland, which set the goal of developing its capacity for “generation of electrical energy from small-scale hydropower (output of up to 10 MW) and biomass” although the company had previously only specialized in “the construction and operation of large-scale hydropower plants and nuclear power plants.” (Gerig 2008: 171) NOK proceeded to take “holdings in the Kompogas Group, which builds biogas plants for anaerobic dry fermentation of green waste,” and in this way expand their capabilities in the field of renewable energies while processing large amounts of “green waste.” (Gerig 2008: 172)

IV.B.

Summary of Policy Recommendations

This chapter focused on proper solid waste management practices as a tool for lowering GHG emissions, particularly with landfills the third leading cause of methane emissions.

(Howarth et al. 2012: 2) Areas to focus on for improved efficiency in waste management include, in the developing world, a reduction in the quantity of organic material sent to landfills; in the developed world, a re-emphasis or re-boot of the scavenger culture (the scavenger culture should also receive increased support and funding in the developing world as an investment in *human capital*). These initiatives could save landfill space, reduce methane emissions, reduce waste collection costs, and create jobs.

For composting or conservation measures to succeed, more infrastructure, incentives, and education could help; the Clean Development Mechanism could play a role here in expanding its funding for and consideration of conservation projects which pay off in the long-term in addition to its focus on technology solutions which provide more upfront returns. These initiatives require consistent coverage in the mainstream media in order to spread awareness of their potential for GHG emissions reductions.

The global environmental protocols summarized in Chapter Two represent the best efforts of the partnership of the international institutions and states. To buoy these efforts, the recommendations in this chapter focused on how to empower the individual to become an actor and a factor in efforts at preventing – even in small amounts – further environmental degradation.

V.

Conclusion

This essay presented the Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC) definitions of climate change as well as the NASA definition of greenhouse gases (GHGs). These definitions, in addition to the

IPCC framework of variables for measuring and understanding climate change and the theory of planetary boundaries (all-encompassing environmental dangers facing the whole globe), conceptualize global environmental degradation.

Section I.B. outlined national security threats of climate change such as resource and energy supply security, and the difficulties faced by vulnerable states. Possibilities for overcoming these security threats involve adaptation and GHG mitigation efforts, a dramatic reduction in GHG emissions, and international alliances to act as enforcement mechanisms. Key challenges to security include heightened competition for ever-scarcer resources which lead to riskier extraction projects such as hydraulic fracturing, and tensions between states over water rights, access to resources, and more.

In Section I.C., analysis centered on international development mechanisms rising to address the obligations derived from the concept of *common but differentiated responsibilities*; this list includes the Clean Development Mechanism (CDM) focused on in Chapter Three. Section I.C. also mentioned the mixed results of state efforts at clean and sustainable development, such as national energy efficiency or energy conservation plans side-by-side with air pollution in developing countries. Additionally, Organisation for Economic Co-operation and Development (OECD) countries have failed to meet voluntary benchmarks on development aid and support.

The methodology of the essay – an analysis of the goals of GHG emissions reductions efforts, funding, and technology transfers through five global environmental protocols over the past thirty years – supports the research question of whether an environmental paradigm gap exists between the intent established in these protocols, and the execution of that intent. This discussion is found in Section I.D.

Chapter Two includes a list of global indicators of environmental degradation such as Arctic ice melt, ocean acidification and more. The chapter continues with a summary of five global environmental protocols over the past thirty years: the Montreal Protocol on Substances that Deplete the Ozone Layer (1987); the Rio Declaration on Environment and Development (1992); the Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997); the Copenhagen Accord (2009); and the Paris Agreement (2015).

Annexes A through C of the Montreal Protocol banned 96 harmful Ozone Depleting Substances (ODS), established the beginnings of *common but differentiated responsibilities* (Southern participation, Northern assistance), and prohibited technology transfers for the production of banned ODS to non-Parties to the Protocol, although no mechanism for non-compliance was established.

The Rio Declaration defined *common but differentiated responsibilities*; although no specific targets were established in the Declaration, it was understood that developed countries would take the lead in enacting this principle. The Declaration called for effective environmental legislation; however, states retained sovereign rights over the resources within their borders and their individual development tracks, which resulted in unchanging rates of emissions growth since 1970.

Under the Kyoto Protocol, binding emissions reductions were established, yet these solely targeted developed nations, an aspect of the Protocol which has received much criticism since the majority of new GHG emissions growth occurs in the industrializing world. The Protocol called for the establishment of funding, insurance, and transfer of technology to the developing world; furthermore, it established the Clean Development Mechanism (CDM) to facilitate and implement these measures.

The phrase *combat climate change* emerged from the Copenhagen Accord, which set the target of stabilizing global warming at 2°C or below. However, the Accord faced criticism in that a 25-member "Friends of the Chair" group spearheaded the writing of the Accord, which thus lacked transparency and inclusion, and was merely "noted" by the international community. A main area of disagreement between states – how to measure GHG emissions, in order to standardize commitments – centered on two metrics, *level of emissions* and *per capita emissions*. The developed world preferred the former, while countries such as China and India preferred the latter as more representative of the spirit of *common but differentiated responsibilities*.

In Paris in 2015, the principle of *nationally determined contributions* based on differentiated capabilities emerged; to this end, developed countries re-affirmed their commitment to providing *climate finance*, and the Paris Agreement called for the establishment of a *Financial Mechanism* and a *Technical Mechanism*. The Agreement also urged global peaking of GHG emissions as soon as possible, and noted that greater emissions reduction efforts are required since the current track of global warming will far exceed the 2°C cap.

Chapter Three explored whether an environmental paradigm gap exists between policy and implementation of these global environmental protocols by focusing on the CDM. The CDM – designed to assist in achieving sustainable development – functions as a market-based mechanism in part by incentivizing the private sector to fund projects. Although the CDM shows promise and makes a difference in the attempt to halt climate change and environmental degradation, analysis of the mechanism found evidence of an environmental paradigm gap, for the following reasons:

- some projects fail due to a lack of commercial viability, lack of capital or access to funds, or their location in politically volatile regions;

- CDM projects are not evenly dispersed geographically, but concentrate in a few dominant countries and regions;
- technology transfers do not occur for all projects (in part because technology providers prefer not to disseminate their technology for fear of imitation); and
- many success stories cannot be definitively credited to the CDM but may instead be due to local capacities.

A few promising projects under the CDM include renewable energy technologies, energy-efficiency projects, and waste management projects (especially since the IPCC identified waste management as one of the seven key sectors contributing to climate change).

Chapter Four offered promising ways forward and policy recommendations. As waste is a main contributor to climate change, waste minimization can directly lead to GHG emissions minimization. As landfill methane contributes 12% of total global methane emissions, composting projects can serve as productive alternatives, especially since organic material can be used as a soil conditioner and save landfill space, and composing creates positive externalities. Recycling, re-use, waste minimization, and waste scavenger efforts do not require high-technology inputs; can create jobs, improve efficiency, and conserve resources; and can empower the individual as an actor in reducing GHG emissions.

VI.

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