ARTICLES

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Healthy Planet, Healthy People: Integrating Global Health into the International Response to Climate Change

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Climate change has been called the defining "human development challenge[] of the [twenty-first] [c]entury."[1] On the one hand, there is increasing scientific certainty that anthropogenic emissions of greenhouse gases (GHG) and destruction of sinks has sped up or forced climate change[2] at such a rate that our technology, our institutional capacity, and our political will may not be sufficient to respond to the challenges it will raise.[3] On the other hand, the process will take place over the course of several decades, and there is still considerable uncertainty about what the exact impacts of climate change will be and how quickly they will occur, particularly at the local level.[4] Policymakers at every level of government are currently grappling with the prospect of massive changes to our way of life that will be required both to mitigate climate change through reduction of emissions and increase of sinks, and to adapt to climate change through changes to human systems. Such changes must ensure that we are better prepared to respond to the impacts of climate change that have, at this point, become either largely inevitable or are already being experienced.

At the annual Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Copenhagen in December 2009,[5] member states addressed the fate of two of the UNFCCC's key projects. The first project was agreement upon a successor to the largely unsuccessful and soon to expire Kyoto Protocol,[6] which has been the basis of the primary climate change mitigation regime at the international level. The second was the negotiation of funding for adaptation to the impacts of climate change in the developing world, which has the potential to dramatically

1 U.N. Dev. Programme [UNDP], *Human Development Report 2007/2008, Fighting Climate Change: Human Solidarity in a Divided World* 31 (2007), *available at* http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf.

2 *See generally* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], *Summary for Policy Makers*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 1, 1–18 (Susan Solomon et al. eds., 2007).

3 *See generally* IPCC, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY (Martin Parry et al. eds., 2007) [hereinafter IPCC, IMPACTS, ADAPTATION AND VULNERABILITY].

4 *Id.*

5 *See* Official Website of the UN Climate Change Conference in Copenhagen COP 15/CMP 5, 7 to 18 December 2009, http://unfcc.int/meetings/cop_15/items/5257.php (last visited Jan. 15, 2010).

6 Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 37 I.L.M. 22 (1998) [hereinafter Kyoto Protocol].

increase resilience to the threats posed by climate change.[7] Sadly, negotiations broke down at the Copenhagen COP and the Accord[8] that was reached by several key parties outside of the U.N. process in the final hours of the COP may do more harm than good for the prospects of a full, binding post–2012 agreement.[9]

The ongoing negotiations on a post–2012 agreement at the international level and implementation of international commitments at the national level include a number of hotly contested issues: (1) what degree of climate change is acceptable as a basis for emissions targets, (2) to what extent and in what ways the mitigation regime should incorporate mitigation approaches in developing countries, (3) whether the mitigation regime can take advantage of the huge mitigation potential of changed practices in the land use and agricultural sectors, (4) how adaptation should be financed and at what level, and (5) what should be the priorities for adaptation funding. Health concerns should play a crucial role in the resolution of all of these issues, but it is by no means certain that they will. Current and future health impacts of climate change have garnered some attention in recent years, but global environmental governance remains grounded in a tradition of natural resources conservation that has not always been receptive to what it casts as an anthropocentric view of environmental issues. Although health impacts have played a role as an important motivation for environmental regulation,[10] environmental governance structures at the national and international level have largely failed to include health advocates and policymakers in a coordinated response to environmental health threats.[11] At the

7 *See generally* UNFCCC, Adaptation Fund, http://unfccc.int/cooperation_and_support/financial_mechanism/adaptation_fund/items/3659.php (last visited Jan. 15, 2010).

8 Copenhagen Accord, Dec. 18, 2009, U.N. FCCC/CP/2009/L.7, *available at* http://unfccc.int/resource/docs/2009/ cop15/eng/l07.pdf (draft decision).

9 Geoffrey Lean, *Copenhagen Blame Game is Obstacle to 2010 Climate Deal*, GRIST, Dec. 29, 2009, http://www.grist.org/article/2009-12-29-copenhagen-blame-game-is-obstacle-to -2010-climate-deal/.

10 *See, e.g.*, Kira Matus et al., *Toward Integrated Assessment of Environmental Change: Air Pollution Health Effects in the USA*, 88 CLIMATIC CHANGE 59, 63 (2008).

11 William Onzivu, *International Environmental Law, the Public's Health, and Domestic Environmental Governance in Developing Countries*, 21 AM. U. INT'L L. REV. 597, 660 (2006); *cf.* UNFCCC, Cooperation with International Organizations, http://unfccc.int/cooperation_and_support/cooperation_with_international_organizations/items/2533.php (last visited Jan. 15, 2010). The UNFCCC website emphasizes that the UNFCCC has been part of significant efforts to enhance coordination among the three Rio Conventions, including the Convention on Biodiversity (CBD), the United Nations Convention to Combat Desertification (UNCCD), and the UNFCCC, all of which are

same time, global health governance has referred to environmental concerns mostly in passing, noting the role of climate change, for example, as one among many transboundary concerns with implications for global health,[12] but rarely delving into the potential of environmental policy as a significant opportunity to better meet the basic survival needs of the world's least healthy people.

The effects of climate change will be experienced in every region, but will disproportionately affect the world's poorest people.[13] In addition to creating novel threats to health and shifting the geographic scope of existing threats, climate change will also act as to amplify current health crises, dramatically increasing the magnitude of preexisting problems ranging from poverty, conflict, and hunger to infectious and chronic disease burdens.[14] In poor countries and in poor communities within wealthy countries, the effects will be monumentally more devastating. The world's poorest and least healthy people also have the least capacity to ameliorate the potentially devastating effects of climate change.[15] Climate change, therefore, not only challenges the international community to find solutions to reduce the health effects, but also to address the inevitable questions of environmental justice.

In recent years, health advocates have begun to raise the profile of health consequences as a major impact of climate change through promotions such as the World Health Organization's (WHO) World

environmental treaties. *Id.* It also indicates its appreciation of statements by other international organizations, including the United Nations Food and Agriculture Organization (FAO), the World Bank, the UNDP, UNCCD, the United Nations Environment Program (UNEP), and the IPCC, on their efforts to address climate change. *Id.* The World Health Organization (WHO) is not mentioned, although its governing body, the World Health Assembly (WHA), adopted a resolution last year addressing the human health impacts of climate change, and indicating that the WHO should advise member states regarding those impacts and work together with the UNFCCC to address them. *See* Sixty-First World Health Assembly, *Climate Change and Health*, at 2, Res. WHA61.19 (May 24, 2008).

12 *See, e.g.*, Robert M. Pestronk et al., *Improving Laws and Legal Authorities for Public Health Emergency Legal Preparedness*, 36 J.L. MED. & ETHICS 47, 47 (Supp. 2008); Thomas E. Novotny, *Global Governance and Public Health Security in the 21st Century*, 38 CAL. W. INT'L L.J. 19, 29, 34 (2007); William H. Frist, *Medicine as a Currency for Peace Through Global Health Diplomacy*, 26 YALE L. & POL'Y REV. 209, 228 (2007).

13 *See generally* IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 393–431 (ch. 8).

14 *See id.* at 358–90 (ch. 7).

15 *See id.* at 471–506 (ch. 10).

Health Day[16] and the American Public Health Association's (APHA) Public Health Week,[17] both of which focused on climate change in 2008. Climate change is expected to act primarily as an intensifier, and to some extent a redistributor, of existing threats to health.[18] Direct effects include excess mortality and morbidity due to exacerbated air pollution, heat waves, hurricanes, floods, wildfires, and other natural disasters.[19] Devastating natural disasters have indirect effects on health as well, including increased infectious disease risk and toxic exposures from contaminated floodwaters or unsanitary shelter conditions.[20] The mental health impacts of natural disasters are also considerable.[21] Climate change also creates fertile conditions for, and alters the geographic range of, infectious disease vectors such as insects and rodents; for example, malaria might be introduced into higher altitudes and dengue fever could be carried further north.[22] Increases in food-borne illnesses, which thrive in warmer conditions, are also anticipated.[23] Worldwide, scarcity of clean, safe water for drinking and sanitation is perhaps the most concerning anticipated impact of climate change. Water scarcity can

16 *See* World Health Organization, World Health Day 2008: Protecting Health from Climate Change, http://www.who.int/world-health-day/previous/2008/en/index.html (last visited Jan. 15, 2010).

17 *See* American Public Health Association, Climate Change: Our Health in the Balance, http://www.nphw.org/nphw08/default.htm (last visited Jan. 15, 2010).

18 *See infra* Part II (discussing health impacts in greater detail).

19 *See generally* Anthony Costello et al., *Managing the Health Effects of Climate Change*, 373 LANCET 1693 (2009).

20 *See generally* J.H. Pardue et al., *Chemical and Microbiological Parameters in New Orleans Floodwater Following Hurricane Katrina*, 39 ENVTL. SCI. & TECH. 8591 (2005).

21 *See, e.g.*, K.L. Middleton et al., *Natural Disasters and Posttraumatic Stress Disorder Symptom Complex: Evidence from the Oklahoma Tornado Outbreak*, 9 INT'L J. STRESS MGMT. 229 (2002); Carmen V. Russoniello et al., *Childhood Posttraumatic Stress Disorder and Efforts to Cope After Hurricane Floyd*, 28 BEHAVIORAL MED. 61, 61 (2002); Pierre Verger et al., *Assessment of Exposure to a Flood Disaster in a Mental-Health Study*, 13 J. EXPOSURE ANALYSIS & ENVTL. EPIDEMIOLOGY 436 (2003); Carol S. North et al., *The Course of PTSD, Major Depression, Substance Abuse, and Somatization After a Natural Disaster*, 192 J. NERVOUS & MENTAL DISEASE 823, 823 (2004); Richard H. Weisler et al., *Mental Health and Recovery in the Gulf Coast After Hurricanes Katrina and Rita*, 296 J. AM. MED. ASS'N 585, 585–86 (2006).

22 *See* IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 407 (ch. 8); Kathryn Senior, *Climate Change and Infectious Disease: A Dangerous Liaison?* 8 LANCET INFECTIOUS DISEASES 92 (2008).

23 *See, e.g.*, R.S. Kovats et al., *The Effect of Temperature on Food Poisoning: A Time-Series Analysis of Salmonellosis in Ten European Countries*, 132 EPIDEMIOLOGY & INFECTION 443, 443 (2004).

be devastating to human health, especially through its impact on diarrheal illnesses, which are among the greatest killers of children in the developing world.[24] Ecosystem changes and water scarcity will in turn impair crop, livestock, and fishery yields, exacerbating what is already a growing food crisis.[25] More remote, but even more devastating impacts may come in the form of economic instability, migration, and armed conflict in a time of competition for increasingly scarce resources.[26]

Preventive health strategies focusing on the environment range from household measures such as safe water storage and food handling practices to energy, transportation, manufacturing, agriculture, land use, and urban planning policies—all areas that are relevant to the ongoing debates surrounding climate mitigation and adaptation approaches.[27] A key lesson of environmental health is that environmental policy interventions can have significant co-benefits for health.[28] There can also be significant gains for social and economic well-being, despite the fact that environmental health is often pitted against economic development considerations in policy debates.[29] Climate policy adds a new layer to complex relationships between the environment, health, and development. Thus far, however, international, national, and even local approaches to climate change have been largely driven by an environmental policy community that has its foundation in natural resources conservation. Unless health policymakers and advocates play a more integral role in the negotiation and implementation of environmental and climate policy, they may miss important opportunities to reduce the global

24 *See generally* A. PRÜSS-ÜSTÜN & C. CORVALÁN, WORLD HEALTH ORG., PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS: TOWARDS AN ESTIMATE OF THE ENVIRONMENTAL BURDEN OF DISEASE (2006), *available at* http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf.

25 *See* CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES [CSIS], A CALL FOR A STRATEGIC U.S. APPROACH TO THE GLOBAL FOOD CRISIS: A REPORT OF THE CSIS TASK FORCE ON THE GLOBAL FOOD CRISIS, CORE FINDINGS AND RECOMMENDATIONS (2008), *available at* http://www.csis.org/media/csis/pubs/080728_food_security.pdf.

26 *See id.*; *see also* INTEGRATED REGIONAL INFORMATION NETWORKS [IRIN], RUNNING DRY: THE HUMANITARIAN IMPACT OF THE GLOBAL WATER CRISIS (2006), *available at* http://www.irinnews.org/pdf/in-depth/Running-Dry-IRIN-In-Depth.pdf; Jeffrey D. Sachs, *Climate Change Refugees*, SCIENTIFIC AMERICAN, June 2007, at 43.

27 *See generally* IPCC, CLIMATE CHANGE 2007: MITIGATION OF CLIMATE CHANGE (Bert Metz et al. eds., 2007) [hereinafter IPCC, MITIGATION OF CLIMATE CHANGE].

28 *See generally* PRÜSS-ÜSTÜN & CORVALÁN, *supra* note 24; Matus et al., *supra* note 10.

29 *See generally* UNDP, *supra* note 1.

disease burden through policy interventions that have the greatest potential for co-benefits for health. The potential for action on both mitigation and adaptation following the Copenhagen COP in December 2009 makes this a critical time for health advocacy. As political momentum in support of strong climate change policy builds, health advocates must act to ensure that mitigation mechanisms take potential co-benefits for health fully into account, and that support for global health infrastructure will be a key part of our international adaptation response.

This Article argues that emphasis on climate change as a fundamental transformation of our environment that will have important consequences for human health has the potential to motivate and shape consensus on mitigation of climate change, while also improving our global health infrastructure as an adaptation to climate change impacts. Part II focuses on the global health burden currently attributable to environmental causes and the anticipated health impacts of climate change. Part III provides background on international climate governance under the UNFCCC and the current status of negotiations. Part IV sets forth an agenda for the integration of global health concerns into the negotiation of a series of key issues currently under debate in the international response to climate change and the national implementation of international obligations. Part V offers a conclusion emphasizing the importance of involving global health policymakers in the response to climate change.

I
ENVIRONMENTAL HEALTH AND THE HEALTH IMPACTS OF CLIMATE CHANGE

In many ways, environmental health has not received policymakers' attention in proportion to its importance as a source of global disease burden. The WHO estimates that nearly one-quarter of the global disease burden, and more than one-third of the disease burden among children under age fourteen, is attributable to modifiable environmental factors such as unsafe water for drinking and sanitation, and air pollution (both indoor and outdoor).[30] The impact of the environment on human health is seen especially in diarrheal illness, lower respiratory infections, unintentional injuries,

30 *See* PRÜSS-ÜSTÜN & CORVALÁN, *supra* note 24, at 9 (measuring disease burden in terms of disability adjusted life years (DALYs)).

and malaria.[31] Approximately ninety-four percent of diarrheal illness worldwide is attributable to modifiable environmental factors, mostly inadequate access to safe drinking water, unsafe sanitation, and poor hygiene practices.[32] Approximately forty-two percent of malaria is attributable to modifiable environmental factors such as land use policies and practices, deforestation, water management, settlement siting, and house design.[33] In turn, diarrheal illness, lower respiratory infections, and malaria are among the biggest contributors to the global burden of disease.[34] The burden of unhealthy environments is shouldered disproportionately by children, particularly in the developing world. WHO estimates that more than four million child deaths each year are attributable to environmental causes, mostly in the developing world, and that the infant death rate from environmental causes is twelve times higher in developing countries than in developed countries.[35] If, as Larry Gostin has suggested, one of the goals of global health law and policy should be to meet the basic survival needs of the world's least healthy people,[36] then environmental health is an excellent starting point. Climate change acts largely as an intensifier and to some extent a redistributor of existing threats to health, acting through the same pathways by which environmental factors are already contributing to global disease burden.[37]

Perhaps the most high profile health impact of climate change is an increase in the severity and frequency, as well as a geographical shift, of extreme weather events. Heat waves are the health threat that is most intuitively connected to climate change, and discussion of the climate-health nexus often focuses on recent heat waves in Europe and North America, which have caused excess mortality measured in tens of thousands of lives.[38] Sea level rise has the potential to

31 *Id.*

32 *Id.*

33 *Id.* at 10.

34 *Id.* at 11.

35 *Id.*

36 Lawrence O. Gostin, *Meeting Basic Survival Needs of the World's Least Healthy People: Toward a Framework Convention on Global Health*, 96 GEO. L.J. 331, 334 (2008).

37 *See generally* Costello et al., *supra* note 19.

38 *See, e.g.*, WHO, Climate and Health: Fact Sheet, July 2005, http://www.who.int/globalchange/news/fsclimandhealth/en/index.html.

dramatically increase storm surge,[39] which in turn plays an important role in determining how destructive a particular storm will be. The geographic distribution of hurricanes and tropical storms will also change, bringing greater frequency of severe storms to some areas.[40] An increase in the frequency and severity of floods, which are the most common severe weather event, is also likely as rising average temperatures intensify evaporation and precipitation in some areas.[41] Out of control wildfires, which are not classified as weather events but are strongly affected by weather conditions, are also likely to become more frequent and more severe in some areas.[42] In addition to causing direct injuries, extreme weather events also have less obvious effects on health. Researchers have pointed to the mental health effects of disasters as a hidden burden on health.[43] We might also see increased exposure to infectious pathogens or toxic chemicals through contaminated floodwaters or unsanitary living conditions following an event.[44] Natural disasters can also cause a dangerous disruption in health care for those suffering from chronic diseases like

39 *See, e.g.*, Pardue et al., *supra* note 20, at 8591; Euripides Euripidou & Virginia Murray, *Public Health Impacts of Floods and Chemical Contamination*, 26 J. PUB. HEALTH 376, 380 (2004); Burkhard Stachel et al., *The Elbe Flood in August 2002—Organic Contaminants in Sediment Samples Taken After the Flood Event*, 40 J. ENVTL. SCI. & HEALTH 265, 266 (2005); Carlos del Ninno & Matthias Lundberg, *Treading Water: The Long-Term Impact of the 1998 Flood on Nutrition in Bangladesh*, 3 ECON. & HUMAN BIOLOGY 67 (2005).

40 *See, e.g.*, Mike Ahern et al., *Global Health Impacts of Floods: Epidemiologic Evidence*, 27 EPIDEMIOLOGIC REVS. 36, 36 (2005); Robert C. Balling Jr. & Randall S. Cerveny, *Compilation and Discussion of Trends in Severe Storms in the United States: Popular Perception v. Climate Reality*, 29 NAT. HAZARDS 103, 107–08 (2003); Kerry Emanuel, *Increasing Destructiveness of Tropical Cyclones Over the Past 30 Years*, 436 NATURE 686, 686 (2005); P.J. Webster et al., *Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment*, 309 SCIENCE 1844, 1846 (2005).

41 *See, e.g.*, Axel Bronstert, *Floods and Climate Change: Interactions and Impacts*, 23 RISK ANALYSIS 545, 555 (2003); K.E. Kunkel, *North American Trends in Extreme Precipitation*, 29 NAT. HAZARDS 291, 301 (2003); C.A. Senior et al., *Predictions of Extreme Precipitation and Sea-Level Rise Under Climate Change*, 360 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON A 1301 (2002).

42 *See, e.g.*, Timothy J. Brown et al., *The Impact of Twenty-First Century Climate Change on Wildland Fire Danger in the Western United States: An Applications Perspective*, 62 CLIMATIC CHANGE 365, 366 (2004); Jeremy S. Fried et al., *The Impact of Climate Change on Wildfire Severity: A Regional Forecast for Northern California*, 64 CLIMATIC CHANGE 169, 170 (2004).

43 Russoniello et al., *supra* note 21, at 61; Verger et al., *supra* note 21, at 436; North et al., *supra* note 21, at 823; Weisler et al., *supra* note 21, at 585–86.

44 *See, e.g.*, Pardue et al., *supra* note 20, at 8591.

HIV/AIDS, diabetes, or cardiovascular disease, for which regular medication and treatment is necessary.

Perhaps even more insidious than high-profile extreme weather events are the more gradually emerging effects on health anticipated as an impact of climate change. For example, exacerbated air pollution will have an impact on cardiovascular and respiratory health.[45] Rising temperatures result in higher levels of ground level ozone pollution (better known as smog), which is formed by chemical reactions between certain air pollutants, including nitrogen oxides and volatile organic compounds,[46] and sunlight.[47] While ozone is beneficial in the upper atmosphere where it provides protection from UV rays, it becomes a harmful pollutant when it forms at ground level. Exposure to ground level ozone pollution can cause short-term, reversible diminished lung function as well as more persistent inflammation of lung tissue.[48] People who live in areas with high ozone concentrations are more likely to suffer from respiratory disease[49] and have a higher risk of premature death.[50] Particulate matter (PM2.5), which includes all airborne particles that are less than 2.5 micrometers in diameter, can be either emitted directly from sources of pollution or formed through atmospheric reactions, which are influenced by rising temperatures, among various pollutant

45 See IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 409–12 (ch. 8).

46 Volatile organic compounds (VOCs), including carbon dioxide and methane, are emitted through the burning of fossil fuels and evaporation from stored fuels, solvents, and other chemicals, as well as evaporation from vegetation. *See, e.g.*, U.S. Geological Survey, Volatile Organic Compounds, http://toxics.usgs.gov/definitions/vocs.html (last visited Jan. 15, 2010).

47 *See, e.g.*, Susan M. Bernard et al., *The Potential Impacts of Climate Variability and Change on Air Pollution-Related Health Effects in the United States*, 109 ENVTL. HEALTH PERSP. 199, 202 (Supp. 2 2001).

48 *See, e.g.*, Lawrence J. Folinsbee et al., *Pulmonary Function and Symptom Responses After 6.6-hour Exposure to 0.12 ppm Ozone with Moderate Exercise*, 38 J. AIR POLLUTION CONTROL ASS'N 28, 28 (1988); Robert B. Devlin et al., *Exposure of Humans to Ambient Levels of Ozone for 6.6 Hours Causes Cellular and Biochemical Changes in the Lung*, 4 AM. J. RESPIRATORY CELL & MOLECULAR BIOLOGY 72, 72–73 (1991).

49 *See, e.g.*, Committee on Environmental Health, American Academy of Pediatrics, *Ambient Air Pollution: Health Hazards to Children*, 114 PEDIATRICS 1699, 1700 (2004); Joel Schwartz, *Short Term Fluctuations in Air Pollution and Hospital Admissions of the Elderly for Respiratory Disease*, 50 THORAX 531, 531 (1995); Rob McConnell et al., *Asthma in Exercising Children Exposed to Ozone: A Cohort Study*, 359 LANCET 386, 386 (2002).

50 *See, e.g.*, Michael Jerrett et al., *Long-Term Ozone Exposure and Mortality*, 360 NEW ENG. J. MED. 1085, 1085 (2009).

gases.[51] Exposure to air pollution, including PM2.5, has been associated with respiratory and cardiovascular effects, ranging from coughing and difficulty breathing, diminished lung function, and exacerbation of asthma to the development of chronic bronchitis and increased incidence of heart attack and arrhythmias.[52]

Researchers also anticipate an increased incidence of zoonotic, vector-, food-, and water-borne diseases as changing environmental conditions affect the survival, persistence, habitat range, and transmission of a variety of pathogens.[53] Vector-borne infectious diseases, such as malaria, dengue fever, West Nile virus, and Lyme disease are those that are spread by blood-feeding arthropods such as mosquitoes and ticks that carry pathogens from human to human. Zoonotic diseases, such as Hantavirus carried by rodents or H5N1 influenza carried by birds, develop in an animal population reservoir and are spread to humans that come into contact with infected animals. Both types of illness are affected by the shifting weather patterns that come with climate change as the habitats and size of animal populations shift in ways that may bring them into greater contact with humans.[54] The impact of climate change on malaria and

51 *See, e.g.*, U.S. Environmental Protection Agency, Fine Particle (PM2.5) Designations, Basic Information, http://www.epa.gov/pmdesignations/basicinfo.htm (last visited Jan. 15, 2010).

52 *See, e.g.*, Douglas W. Dockery et al., *An Association Between Air Pollution and Mortality in Six U.S. Cities*, 329 NEW ENG. J. MED. 1753, 1753 (1993); Jonathan M. Samet et al., *Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987–1994*, 343 NEW ENG. J. MED. 1742, 1742 (2000); C. Arden Pope, III et al., *Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults*, 151 AM. J. RESPIRATORY & CRITICAL CARE MED. 669, 669 (1995); C. Arden Pope III & Douglas W. Dockery, *Health Effects of Fine Particulate Air Pollution: Lines that Connect*, 56 J. AIR & WASTE MGMT. ASS'N 709, 709 (2006); Francesca Dominici et al., *Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases*, 295 J. AM. MED. ASS'N 1127, 1127 (2006); Francine Laden et al., *Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-up of the Harvard Six Cities Study*, 173 AM. J. RESPIRATORY & CRITICAL CARE MED. 667, 667 (2006).

53 *See, e.g.*, IPCC, IMPACT, ADAPTATION AND VULNERABILITY, *supra* note 3, at 408 (ch. 8); Senior, *supra* note 22.

54 *See generally* D.J. Rogers & S.E. Randolph, *Climate Change and Vector-Borne Diseases*, 62 ADVANCES IN PARASITOLOGY 345, 353–54 (2006); P. Gale et al., *Predicting the Impact of Climate Change on Livestock Disease in Great Britain*, 162 VETERINARY REC. 214, 214 (2008); John S. Brownstein et al., *A Climate-Based Model Predicts the Spatial Distribution of the Lyme Disease Vector* Ixodes Scapularis *in the United States*, 111 ENVTL. HEALTH PERSP. 1152, 1152 (2003); R.S. Kovats et al., *Early Effects of Climate Change: Do They Include Changes in Vector-Borne Disease?*, 356 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B 1057 (2001); Simon Hales et al., *El Niño and*

dengue fever, the vector-borne illnesses with the greatest disease burden, are particularly concerning. Increased rainfall and temperatures have a significant impact on increasing the length of the transmission season and altering the geographic distribution of vector mosquitoes, both in terms of latitudinal and altitudinal distribution.[55] Climate change is expected to bring major changes in the risk of malaria in areas that are at the edges of current geographical distribution.[56] Food-borne illness is also sensitive to climate change as higher ambient temperatures allow food-borne pathogens to thrive.[57] Salmonellosis has been shown to be particularly sensitive to increased temperatures.[58] Campylobacteriosis, on the other hand, is less sensitive to changes in temperatures, but is affected by climate change as a result of its impact on water scarcity, as discussed below.[59] Higher ocean surface water temperatures also have an impact on food poisoning through the effect of harmful algal blooms[60] and methylation of mercury[61] on shellfish and reef fish contamination.

Scarcity of clean, safe water for drinking and sanitation is perhaps the most concerning anticipated impact of climate change. Water scarcity can be devastating to human health,[62] especially due to its impact on diarrheal illnesses, which are among the greatest killers of children in the developing world.[63] Incidence of water-borne diseases, such as cholera, cryptosporidiosis, and campylobacteriosis, is expected to rise as a result of climate change due to droughts, which concentrate pathogens in pools, and floods, which increase

the Dynamics of Vectorborne Disease Transmission, 107 ENVTL. HEALTH PERSP. 99 (1999).

55 *See* ICCP, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 407 (ch. 8).

56 *Id.*

57 *See, e.g.*, Kovats et al., *supra* note 23, at 443.

58 *Id.*

59 *See, e.g.*, R. Sari Kovats et al., *Climate Variability and Campylobacter Infection: An International Study*, 49 INT'L. J. BIOMETEOROLOGY 207, 210 (2004).

60 IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 400 (ch. 8).

61 *Id.*

62 *See, e.g.*, CORRINE J. SCHUSTER-WALLACE ET AL., SAFE WATER AS THE KEY TO GLOBAL HEALTH (2008), *available at* http://www.inweh.unu.edu/Health/docs/2008PolicyBrief.pdf; Bettina Menne & Roberto Bertollini, *The Health Impacts of Desertification and Drought*, DOWN TO EARTH (Convention to Combat Desertification, Bonn, F.R.G.), Dec. 2000, at 4.

63 *See* PRÜSS-ÜSTÜN & CORVALÁN, *supra* note 24, at 9 (measuring disease burden in terms of DALYs).

runoff and microbial contamination of water supplies.[64] Water-washed diseases, illnesses for which the main transmission pathway is not through contaminated water, but which are affected by hygiene practices and thus sensitive to water scarcity such as rotavirus, are also expected to be significantly affected by climate change.[65]

Over a longer time horizon, we may see even more serious threats to health due to major changes in human settlements and increasing armed conflict as a result of climate change and sea level rise.[66] We could see widespread food and water insecurity on an unprecedented scale as the global food and water crises that are already occurring as a result of population growth, environmental degradation, and economic factors[67] are exacerbated by climate change. The mutually reinforcing trends of climate change and environmental degradation are "likely to make many parts of the world uninhabitable, or at least uneconomic," potentially resulting in mass migration both within and across national borders.[68]

II
THE INTERNATIONAL RESPONSE TO CLIMATE CHANGE

A. International Cooperation for Climate Change Mitigation and Adaptation

In 1992, most nations of the world including the United States signed the UNFCCC, which went into effect in 1994.[69] As a framework convention, the UNFCCC did not itself create significant legally binding obligations. Rather, it set forth the broad goal of stabilizing atmospheric GHG concentrations at a level that would prevent dangerous anthropogenic interference with the global climate system within a time frame that would allow for natural adaptation of ecosystems to climate change, protection of food production, and sustainable economic development.[70] The UNFCCC's climate

64 IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 401 (ch. 8).

65 *Id.* at 400 (ch. 8).

66 *See, e.g.*, LESTER R. BROWN, PLAN B 3.0: MOBILIZING TO SAVE CIVILIZATION (2008).

67 *See* CSIS, *supra* note 25; *see also* IRIN, *supra* note 26.

68 Sachs, *supra* note 26, at 43.

69 *See* UNFCCC, Status of Ratification, http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php (last visited Jan. 15, 2010).

70 UNFCCC art. 2, May 9, 1992, S. TREATY DOC. NO. 102-38, 1771 U.N.T.S. 107.

change mitigation policy is directed primarily at industrialized countries, and its original goal was to stabilize those countries' GHG emissions at 1990 levels by the year 2000. As of 2009, 192 countries had ratified the UNFCCC.[71]

In 1997, following particularly tense negotiations at the Kyoto COP to the UNFCCC, the parties adopted the Kyoto Protocol, which went into force in 2005.[72] In the agreement that was eventually hashed out despite considerable discord between the U.S. and EU delegations, thirty-seven developed countries and the European community, listed in Annex 1, agreed to reduce their emissions of GHGs to at least five percent below 1990 levels by 2012.[73] Developing countries were not committed to binding targets, though they had the option of establishing voluntary targets.[74] In addition to emissions reduction targets, the agreement established a system of emissions trading, joint implementation, and clean development mechanisms to encourage cooperation between developed and developing countries to reduce emissions. Although the United States signed the Protocol, it is the only major developed country that has not ratified it. In 1997, the U.S. Senate passed a unanimous resolution stating that the United States should not be a signatory to any protocol that did not include binding emissions reduction targets for developing as well as developed countries.[75] The Clinton administration never sent the Protocol to the Senate for ratification, and the Bush administration openly opposed ratification, arguing that China and India were not bound to emissions reduction targets, and that participation in such a regime would unjustifiably disadvantage the U.S. economy against these emerging competitors.[76]

B. Negotiation of a Successor to the Kyoto Protocol

Because the United States refused to ratify the Kyoto Protocol, and because virtually all of the countries that did ratify have thus far fallen

71 *See* UNFCCC, Convention, http://unfccc.int/essential_background/convention/items/2627.php (last visited Jan. 15, 2010).

72 *See generally* Kyoto Protocol, *supra* note 6.

73 *Id.*

74 *Id.*

75 *See* S. Res. 98, 105th Cong. (1997).

76 *See, e.g.*, Tony Karon, *When it Comes to Kyoto, the U.S. is the "Rogue Nation,"* TIME, July 24, 2001, http://www.time.com/time/world/article/0,8599,168701,00.html; *Bush Faces Up to Kyoto Critics*, BBC NEWS, June 11, 2001, http://news.bbc.co.uk/2/hi/americas/1382564.stm.

far short of meeting their obligations under it,[77] the Kyoto Protocol has been widely regarded as a failure.[78] In any case, the commitments contained in the Kyoto Protocol expire in 2012 and the UNFCCC member states began to sketch out what a successor GHG emissions reduction regime might look like, and to establish milestones to stay on track for negotiation of a successor protocol. At the 2007 COP in Bali, the United States joined other nations in agreeing to negotiate a successor protocol by the end of 2009 as part of the Bali Action Plan.[79] Although a change in the U.S. presidential administration may make U.S. participation in the Kyoto successor regime possible, any agreement would still have to be ratified by two-thirds of the U.S. Senate. Unfortunately, ratification by such a majority is unlikely unless emerging economies that are important competitors for the United States are bound to emissions reduction targets. Draft agreements were presented by the chair and discussed by the parties during negotiation sessions in Bonn, Germany, in June and August of 2009.[80] Ultimately, however, much of the substance of the new mitigation regime was left unsettled leading up to the December 2009 COP in Copenhagen.[81] The Intergovernmental Panel on Climate

77 *Environment: Call for Agreement to Replace Kyoto Protocol*, KEESING'S WORLD NEWS ARCHIVES, Aug. 28, 2009, http://www.keesings.com/breaking_history/international/environment_call_for_agreement_to_replace_kyoto_protocol_pub._aug._28,_2009/environment_call_for_agreement_to_replace_kyoto_protocol_-_full_text.

78 *See, e.g.*, Gwyn Prins & Steve Rayner, *Time to Ditch Kyoto*, 449 NATURE 973 (2007); Patrick J. Michaels, *Lessons of Kyoto*, NATIONAL REVIEW ONLINE, Sept. 26, 2007, http://article.nationalreview.com/?q=NzYwMjZkNDQwNjczOGUyMTBhZWVhMjRjNjFlMDVhNDg. In the lead-up to the Copenhagen COP, some commentators sought to dispel the generally accepted notion that Kyoto was an abject failure, presumably in an effort to combat popular perception that emissions reductions would not be ensured even if parties were successful in their efforts to negotiation binding limits at the COP. *See, e.g.*, Bill Chameides, *Did the Kyoto Protocol Miss the Target?* HUFFINGTON POST, Oct. 12, 2009, http://www.huffingtonpost.com/bill-chameides/did-the -kyoto-protocol-mi_b_317855.html (arguing that it is too early to declare Kyoto a failure and that "[i]n all likelihood when 2012 rolls around, we will find that overall its Annex B countries will have cut emissions by more than the intended 5.2 percent").

79 UNFCCC Conference of the Parties, Bali Action Plan, Dec. 1/CP.13, *in* Report on Conference of the Parties on its Thirteenth Session, U.N. Doc. FCCC/CP/2007/6/Add.1 (Mar. 14, 2008).

80 *See* UNFCCC, Bonn Climate Change Talks—June 2009, http://unfccc.int/meetings/sb30/items/4842.php; UNFCCC, Bonn Climate Change Talks—August 2009, http://unfccc.int/meetings/intersessional/bonn_09_2/items/4913.php.

81 Sven Harmeling & Christoph Bals, *Political Will at the Highest Level Needed: A Hesitant Beginning to the "Countdown to Copenhagen" at the Climate Negotiations in Bonn, June 2009*, GERMANWATCH, http://www.germanwatch.org/klima/sb30rese.pdf (last visited Jan. 15, 2010).

Change (IPCC) had recommended that in the Copenhagen agreement industrialized countries must commit to reducing their emissions by twenty-five to forty percent compared to 1990 levels by 2020 to remain close to a two degrees Celsius rise in average temperatures.[82] Early on, it became apparent that such a commitment was unlikely. At the 2008 COP in Poznan, the European Union, Norway, and Switzerland were among the only parties who expressed some willingness to seriously negotiate on this point.[83]

Ultimately, the 2009 COP utterly failed to achieve a full, U.N.-based agreement to succeed the Kyoto Protocol. Two weeks of negotiations were plagued by delays and seemingly insoluble disagreements. Then, at the last minute the United States and China, joined by key rapidly industrializing countries India, Brazil, and South Africa, attempted to salvage the COP with the Copenhagen Accord. The agreement includes a relatively vague commitment to work towards curbing global temperature rise to below two degrees Celsius.[84] The Accord is voluntary and postpones setting binding targets, but it does bring together key parties that are not subject to emissions reduction under Kyoto.[85] Interestingly, the Accord was negotiated outside of the UNFCCC process and was noted, but not adopted by the UNFCCC member states at the close of the Copenhagen COP.[86] How the Accord and the failure at Copenhagen will affect future efforts to negotiate a full post–2012 agreement is at this point unclear.[87] Many commentators have noted that Copenhagen and the lead-up to it revealed serious flaws in the U.N.

82 IPCC, MITIGATION OF CLIMATE CHANGE, *supra* note 27, at 776.

83 CHRISTOPH BALS, BETWEEN POZNAN AND COPENHAGEN: THE CLIMATE TRAIN IN THE "VALLEY OF DEATH" 4 (2009), *available at* http://www.germanwatch.org/klima/c14rese.pdf.

84 Copenhagen Accord, *supra* note 8.

85 *U.S., China Step Forward in Climate Debate* (NPR radio broadcast Dec. 24, 2009), http://weblogs.npr.org/templates/transcript/transcript.php?storyId=121846177.

86 Press Release, Friends of the Earth, UN Climate Conference Closes Without Adopting 'Copenhagen Accord' (Dec. 19, 2009), *available at* http://www.foe.org/un-climate-conference-closes-without-adopting-copenhagen-accord; *Summary of the Copenhagen Climate Change Conference: 7-19 December 2009*, EARTH NEGOTIATIONS BULL. (Int'l Inst. for Sustainable Dev., New York, N.Y.), Dec. 22, 2009, at 1–2, *available at* http://www.iisd.ca/download/pdf/enb12459e.pdf ("During informal negotiations facilitated by UN Secretary-General Ban Ki-Moon during the night and early morning, parties agreed to adopt a COP decision whereby the COP 'takes note' of the Copenhagen Accord, which was attached to the decision as an unofficial document.").

87 *See, e.g.*, Lean, *supra* note 9 (summarizing various positions laying blame for the failure at Copenhagen).

negotiating regime, which could continue to stymie efforts in 2010 and beyond if they are not addressed.[88]

C. The Adaptation Regime

Whereas mitigation efforts seek to avoid harmful anthropogenic climate change, or at least reduce its extent, adaptation efforts seek to reduce the vulnerability of human settlements to the impacts of climate change. Adaptation measures seek to build "ecological and social community resilience to climate change."[89] Ecological resiliency includes "protecting and preserving the natural ecosystems that help human communities survive through buffering from floods, filtering drinking water, stabilizing soil, providing sustainable forest products, and preserving a host of other ecosystem services necessary for human survival."[90] In the context of climate governance under the UNFCCC, ecological resiliency is not pursued for the purpose of "preserving functioning ecosystems and their myriad component species for their own sake,"[91] though that is a purpose of other international environmental agreements such as the Convention on Biological Diversity.[92] Social resiliency includes "forging the democratic capacity to help marginalized communities accrue the administrative, technical, and political power that will help them make difficult decisions and survive the coming vicissitudes of nature and the coming economic and political upheavals . . . that are now befalling and will continue to befall them."[93] More specific to the concerns of global health law, adaptation of human systems includes the building of capacity, including through law and policy reform, to face the anticipated health impacts of climate change.

88 *See, e.g.*, Joe Churcher, *Gordon Brown: Small Number of Countries Held Copenhagen Talks to Ransom*, INDEPENDENT, Dec. 21, 2009. U.N. Secretary General Ban Ki-Moon has called for investigation of potential reforms to the U.N. negotiations process. *See United Action on Global Scale Needed to Cinch New Climate Pact, Says Ban*, UN NEWS CENTRE, Dec. 21, 2009, *available at* http://www.un.org/apps/news/story.asp?NewsID=33311&Cr=copenhagen&Cr1=.

89 David Takacs, *Carbon into Gold: Forest Carbon Offsets, Climate Change Adaptation, and International Law*, 15 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 39, 43 (2009).

90 *Id.* at 44.

91 *Id.*

92 Convention on Biological Diversity art. 1, June 5, 1992, 1760 U.N.T.S. 79.

93 Takacs, *supra* note 89, at 44.

Article 2 of the UNFCCC sets a goal of stabilizing atmospheric GHG emissions at a level that would "allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."[94] Since it has become increasingly clear that mitigating climate change is unlikely to be achieved, at least to the point where natural adaptation is possible, attention has shifted to planned adaptation of human systems. The concept of planned adaptation of human systems to climate change has always been a part of the UNFCCC. For example, Article 4.4 of the UNFCCC requires that developed countries "shall also assist the developing country [p]arties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects."[95] Until relatively recently, however, adaptation has taken a backseat to mitigation efforts.

Focus on adaptation has been somewhat controversial within the environmental advocacy and climate science communities because some fear that it will reduce the impetus for mitigation efforts by admitting that mitigation efforts are unlikely to reduce anthropogenic climate change at a fast enough rate to prevent significant impacts, and by casting those impacts as manageable through technological and social advances.[96] On the other hand, by "shift[ing] the question from whether impacts from climate change will occur in the near term, and whether some portion will be unacceptable, to the hows of achieving some control over the more dire consequences expected,"[97] the adaptation question has in some ways moved the climate community forward, and has created the opportunity for greater engagement of scientific, advocacy, and policy communities in other fields, including agriculture and global health. Additionally, the focus on adaptation, by making the discussion of climate change impacts more concrete, is also more amenable to the framing of climate change as an environmental justice issue. Research on projected impacts, and on the likely vulnerability and adaptation capacity of

94 UNFCCC, *supra* note 70, at art. 2.

95 *Id.* at art. 4.4.

96 *See, e.g.*, Mark Hertsgaard, *On the Front Lines of Climate Change*, TIME, Apr. 9, 2007, at 102; Rick Salutin, *Adaptation Equals Doing Nothing*, RABBLE.CA, Feb. 9, 2007, http://www.rabble.ca/columnists/adaptation-equals-doing-nothing.

97 *Preface* to INTEGRATION OF PUBLIC HEALTH WITH ADAPTATION TO CLIMATE CHANGE: LESSONS LEARNED AND NEW DIRECTIONS, at xviii (Kristie L. Ebi et al. eds., 2005).

various regions, highlights the fact that climate change is largely driven by industrialized nations.[98] Yet, the adverse impacts of climate change will be felt first and foremost by those in developing nations who have the least capacity to adapt to such impacts.[99]

In 2006, at the Nairobi COP, member states negotiated the establishment of the Kyoto Protocol Adaptation Fund and the Nairobi Work Program on Adaptation.[100] The Fund is generated by a two percent tax levied on Clean Development Mechanism (CDM) projects, which are emissions offset projects undertaken by industrialized countries, primarily by way of private enterprises in the developing world.[101] This innovative funding mechanism has the potential to create an adaptation budget that could be as much as five times the budgets of the two previously created climate change funds, which relied on direct funding from donor countries.[102] The Adaptation Fund is expected to generate between $160 and $950 million per year between now and 2012, the year the Kyoto Protocol expires.[103] The Fund is dedicated to enabling concrete adaptation activities, and experts are anticipating a frenzy of proposals seeking a piece of the pie.

98 *See* Costello et al., *supra* note 19, at 1712.

99 *See id.*

100 Benito Müller, *The Nairobi Climate Change Conference: A Breakthrough for Adaptation Funding*, OXFORD ENERGY & ENV'T COMMENT, Jan. 2007, at 1, *available at* http://www.oxfordenergy.org/pdfs/comment_0107-1.pdf.

101 The CDM has a somewhat controversial past. It grew out of a proposal by Brazil, with the support of the G-77 nations, as a means to compel Annex 1 countries to meet their emissions reduction targets by requiring a fine for emissions in excess of their targeted limits. Takacs, *supra* note 89, at 53–54. The fines would then be used to fund mitigation and adaptation projects in developing countries. *Id*. Eventually, however, the program morphed into a mechanism for allowing industrialized countries, and more specifically private actors within them, to avoid real emissions reductions while making a profit at the same time. *Id.* Private enterprises can use CDM projects in developing countries, primarily China, Brazil, Mexico, and India, which have the infrastructure to meet the bureaucratic and technical requirements imposed by the CDM to offset requirements imposed on them by their respective governments. *Id.* They can also profit by selling or trading credits in an emissions trading regime. *Id*.

> Much, if not most of the U.N.-sponsored effort in the past ten years around climate change has gone into making a functional CDM, much to the benefit of business interests around the world. Private actors generated $US30 billion per year worth of CDM projects in 2006, the first year after the Kyoto Protocol went into effect.

Id. at 54.

102 Müller, *supra* note 100, at 2.

103 *Id.*

The Adaptation Fund Board has indicated that it wishes to implement "[a]daptation activities where sufficient information is available to warrant such activities, *inter alia*, in the areas of: (i) water resources management, (ii) land management, (iii) agriculture, (iv) health, (v) infrastructure development, (vi) fragile ecosystems, including mountainous ecosystems, and (vii) integrated coastal zone management."[104] Because the United States has not ratified the Kyoto Protocol, it does not currently have any direct means of influencing decisions with respect to the Adaptation Fund. Instead, the European Union has taken on a leadership role. Significant progress was made in 2008 and 2009 on readying the Adaptation Fund for implementation. The basic structure of the fund was established, and the groundwork was laid for a large-scale finance architecture to be negotiated in Copenhagen.[105] Much to the chagrin of developing countries, however, industrialized countries expressed considerable reluctance toward increasing the funding through a variety of mechanisms that have been proposed.[106]

Financing of adaptation in developing countries is intimately linked to the potential success of a post–2012 mitigation regime.[107] Developing countries at the Bali COP in 2007 expressed that their willingness to participate in the mitigation regime hinged on the scaling up of funding for adaptation.[108] Indeed, funding for adaptation in developing countries was a major focus of negotiations at the Copenhagen COP.[109] Ultimately, in the Copenhagen Accord, developed countries committed to a short-term financing goal of approximately $80 billion for the period from 2010 to 2012, with a balance between mitigation and adaptation, and a long-term goal of

104 Adaptation Fund Board, *Draft Provisional Operational Policies and Guidelines for Parties to Access Resources from the Adaptation Fund*, at 7, AFB/B3.8 (Aug. 26, 2008), *available at* http://www.adaptation-fund.org/images/AFB.B.3.8_Operational_Policies_and_Guidelines_08.26.08_-_revised.1.pdf.

105 *See* Sven Harmeling & Alpha Kaloga, *Adaptation Fund: Critical Progress at the 7th Meeting*, GERMANWATCH, Sept. 2009, *available at* http://www.germanwatch.org/klima/afb2009-09r.pdf.

106 SVEN HARMELING, ADAPTATION UNDER THE UNFCCC—THE ROAD FROM BONN TO POZNAN 2008, at 6 (2008), *available at* http://www.germanwatch.org/klima/bonnadapt08e.pdf.

107 *See* Eric J. Lyman, *Kyoto: Power Shift in the Making*, ISN SECURITY WATCH, June 19, 2009, http://www.isn.ethz.ch/isn/Current-Affairs/Security-Watch/Detail/?id=102025&Ing=en.

108 BALS, *supra* note 83, at 4.

109 *See Summary of the Copenhagen Climate Change Conference: 7–19 December 2009*, *supra* note 86, at 3.

$100 billion by 2020 "to address the needs of developing countries."[110] At this point, it is not clear how much of this funding will be committed to adaptation or whether any of it will flow through the UNFCC Adaptation Fund.[111]

Although recent developments indicate significant progress on the development of an adaptation regime under the UNFCCC, adaptation in the developing countries that are at greatest risk of catastrophic climate impacts suffers from an implementation gap,[112] as funds have not been provided and the infrastructure required to make use of adaptation funding is not in place in the poorest countries.[113] One of the great ironies of climate change adaptation is that countries that are likely to see the least severe impacts from climate change have spent monumentally more on adaptation within their borders than they have donated to adaptation in the poorest countries, where far more significant impacts will be felt.[114] While developed nations are currently spending about $40 million per year to fund adaptation in developing countries, they are spending about $40 billion per year on their own adaptation projects.[115]

III
THE ROLE OF HEALTH ADVOCACY IN THE NEGOTIATION AND IMPLEMENTATION OF A POST–2012 FRAMEWORK

A. Putting a Human Face on Climate Change

Policymakers, advocates, and scholars alike have noted that putting a human face on climate change could be the key to generating the massive amount of political will that will be required to effectively respond to climate change. Roberto Bertolini of the WHO says that

110 United States Climate Action Network, Understanding the Copenhagen Accord, http://www.usclimatenetwork.org/policy/understanding-the-copenhagen-accord (last visited Feb. 4, 2010).

111 ALPHA KALOGA & SVEN HARMELING, THE ADAPTATION FUND IN COPENHAGEN: SUMMARY OF OUTCOMES (Dec. 2009), *available at* http://www.germanwatch.org/klima/afb2009-12.pdf.

112 *Id.*

113 Takacs, *supra* note 89, at 53 (stating that eighty percent of CDM projects, which develop mitigation and adaptation capacity in the developing world, are in Brazil, China, Mexico, and India, where infrastructure is advanced enough to meet the bureaucratic and technical requirements imposed by the CDM).

114 *See supra* text accompanying notes 13–15.

115 Takacs, *supra* note 89, at 56 (citing Andrew C. Revkin, *Poor Nations to Bear Brunt as World Warms*, N.Y. TIMES, Apr. 1, 2007, at A1).

he hopes that climate change will bring to mind the image of a malnourished child in Africa dying of diarrheal illness rather than the image of a drowning polar bear.[116] Lisa Heinzerling, a legal scholar who was recently named Senior Climate Counselor to the Administrator of the Environmental Protection Agency, has argued that the characterization of climate change as "knowing killing" of people in the developing world creates a moral obligation on the part of industrialized countries to respond.[117] At the opening session of the Copenhagen COP, Algeria spoke for African member states highlighting the fact that "Africans are already impacted by climate change through increased droughts, health hazards, food scarcity and migration."[118]

But beyond these broad strokes and general references to the connection between climate change and global health, what are the concrete opportunities for health advocates to influence the international response to this emerging threat? As a good starting point, putting a human face on climate change has an important role to play in reaching an agreement on a limit beyond which the extent of climate change becomes unacceptable. As discussed above, the objective of the UNFCCC is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[119] What that level is and what the timeframe should be is still a matter of debate.

The goal that gained consensus in negotiations leading up to Copenhagen, but agreement upon which is still far from certain, is to limit global warming to a global mean surface temperature rise of two degrees Celsius. In the months leading up to Copenhagen, a growing number of parties began calling for an even stricter limit of 1.5 degrees Celsius, based on concerns that the impacts even at a two degrees Celsius increase are unacceptable.[120] The European Union, Norway, Iceland, African nations, and Chile joined the Alliance of Small Island States (AOSIS) in campaigning for this stricter limit, and

116 Conversation with Roberto Bertolini, Dir., Special Programme on Health & Env't, World Health Org. (Jan. 21, 2009).

117 Lisa Heinzerling, *Climate Change, Human Health, and the Post-Cautionary Principle*, 96 GEO. L.J. 445, 460 (2008).

118 *See Summary of the Copenhagen Climate Change Conference: 7–19 December 2009*, *supra* note 86, at 3.

119 UNFCCC, *supra* note 70, at art. 2.

120 *See* BALS, *supra* note 83, at 6.

other developing countries indicated that they may join the effort as well.[121] IPCC Chairman Rajendra Pachauri stated that the two degrees Celsius limit may not be ambitious enough, and activist Al Gore publicly called for a 1.5 degrees Celsius limit.[122] The Copenhagen Accord commits parties to a two degrees Celsius limit, but also includes ambiguous language regarding further investigation of a 1.5 degrees Celsius limit.[123]

Even to limit global warming to an increase of two degrees Celsius, the IPCC has recommended that GHG emissions must be reduced by twenty-five to forty percent of 1990 levels by 2020.[124] By way of comparison, in the fall of 2009 the Obama administration indicated a willingness to cut emissions to 1990 levels, the so called "zero percent target," by 2020.[125] The Kyoto Protocol commits thirty-seven industrialized countries and the European Union to reducing emissions to five percent below 1990 levels by 2012, and parties have failed to meet even those modest targets.[126] The European Union recently indicated willingness to commit to a thirty percent reduction below 1990 levels by 2020, contingent upon an agreement by other nations to do the same.[127] Although this was the most ambitious target announced by any industrialized country, experts believe that even a reduction of this scale may not be sufficient to limit global warming to under two degrees Celsius.[128]

The campaign for consideration of a 1.5 degrees Celsius pathway has been driven in large part by arguments regarding sovereignty and the claim that no nation's survival is negotiable.[129] In addition to considering whether some small island states would cease to exist altogether under the two degrees Celsius scenario, however,

121 *Id.*

122 *Id.*

123 Copenhagen Accord, *supra* note 8, ¶ 12 ("We call for an assessment of the implementation of this Accord to be completed by 2015, including in light of the Convention's ultimate objective. This would include consideration of strengthening the long-term goal referencing various matters presented by the science, including in relation to temperature rises of 1.5 degrees Celsius.").

124 BALS, *supra* note 83, at 4.

125 *See* John Heilprin, *Obama on Climate Change: U.S. 'Determined to Act,'* HUFFINGTON POST, Sept. 22, 2009, http://www.huffingtonpost.com/2009/09/22/un-climate-summit-puts-ch_n_294409.html.

126 *Environment: Call for Agreement to Replace Kyoto Protocol*, *supra* note 77.

127 *See* BALS, *supra* note 83, at 9.

128 *Id.*

129 *Id.*

policymakers should highlight the considerable difference in impacts, particularly health impacts, that might be seen between the two paths. The two degrees Celsius limit appears to be the point at which sea level rise would be severe enough that millions more people would experience coastal flooding,[130] though increasingly scientists believe that point may be reached at the 1.5 degrees Celsius mark. Most of the health impacts described above begin at the 0.5 degrees Celsius point, however, and some of them are already in evidence today. Localized impacts on food security are currently in evidence, but experts believe that decreases in crop yields will become widespread by the one degree Celsius point, and will reach critical levels by 3.5 degrees Celsius.[131] Water stress is increased at an extremely low threshold and worsens rapidly with increasing average temperatures.[132] More research is needed to assess the relationship between the severity of health impacts and increasing average temperatures, but the argument here is that emphasis on health impacts likely to be felt by a large portion of the world's population may be more persuasive than primarily pointing toward individual nations with relatively small populations that will be utterly devastated.

B. Sectoral Approaches to Mitigation with Co-Benefits for Health

In addition to providing a more compelling justification for climate change mitigation, health concerns might shape the contours of the mitigation regime at the international level, as well as national level implementation of international obligations. Health advocates should pay particular attention to the incorporation of land use regulation into climate change mitigation strategies. Worldwide, poor land use management, particularly deforestation, accounts for a greater share of GHG emissions than either the transportation or industrial sectors—more than twenty percent of total emissions.[133] Creation and maintenance of biological sinks for carbon is a difficult area to regulate due to monitoring and measurement challenges, but it has important co-benefits for health, as well as for biodiversity and

130 *See, e.g.*, IPCC, IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 3, at 688–716 (ch. 16).

131 *Id.*

132 *Id.*

133 *See* D. Schoene & M. Netto, *The Kyoto Protocol: What Does it Mean for Forests and Forestry?*, 56 UNASYLVA 3 (2005).

support of sustainable livelihoods.[134] Reforestation and avoided deforestation have gained ground in UNFCCC negotiations and may play a significant role in the post–2012 mitigation regime, primarily through the Clean Development Mechanism (CDM).[135] Promotion of sustainable agricultural practices to reduce emissions and increase sinks has not played a major role in international climate governance, but could still be an important part of national level strategies to meet targets imposed by Kyoto and its successor. Of course, the incorporation of land use, forest-based, and agricultural mitigation approaches into the post–Kyoto regime should be undertaken in such a way that it will supplement, rather than supplant, emissions reductions from more traditional sources in the industrialized world. Transport,[136] industrial,[137] and energy[138] sector emissions also have more direct, local impacts on health in addition to their impact through climate change. Most experts agree, moreover, that mitigation from all sectors and in both industrialized and developing nations will be necessary to hold the extent and rate of climate change within boundaries that allow for successful adaptation.[139]

Proponents of forest-based mitigation approaches see reforestation, whereby "a project developer plants trees to reforest a degraded ecosystem,"[140] and avoided deforestation, whereby a project

134 Mohamed T. El-Ashry, *An Overview of this Issue: Framework for a Post-Kyoto Climate Change Agreement*, SUSTAINABLE DEV. L. & POL'Y, Winter 2008, at 2, 3.

135 Takacs, *supra* note 89, at 57–58 (noting that "[c]urrent Kyoto Protocol rules allow only [one] percent of carbon credits under the CDM to be allotted for projects in Land Use, Land-Use Change and Forestry (LULUCF)" and that avoided deforestation projects "are currently excluded from CDM eligibility, but it is expected they will be a part of the successor to the Kyoto Protocol").

136 The transportation sector's current reliance on fossil fuels plays a major role in ground-level ozone and particulate matter air pollution with its resulting impacts on cardiovascular and respiratory health. *See, e.g.*, AM. PUB. HEALTH ASS'N, CLIMATE CHANGE IS A PUBLIC HEALTH ISSUE (2008), *available at* http://www.nphw.org/nphw08/NPHW%202008%20Blueprint.pdf. A shift to greater use of public transportation and nonmotorized transport has significant co-benefits for health in terms of reduction in obesity and cardiovascular disease and improved mental health. *Id.*

137 Industrial emissions of carbon dioxide and other GHGs have impacts on air, soil, and water pollution with resulting impacts on health. *See supra* Part II.

138 The energy sector's current reliance on coal-fired power plants has significant impacts on air pollution, as well as soil and water pollution, with resulting health impacts. *See generally* Frederica Perera et al., *Benefits of Reducing Prenatal Exposure to Coal-Burning Pollutants to Children's Neurodevelopment in China*, 116 ENVTL. HEALTH PERSP. 1396 (2008).

139 IPCC, MITIGATION OF CLIMATE CHANGE, *supra* note 27, at 542–84 (ch. 9).

140 Takacs, *supra* note 89, at 56.

developer "ensures that a forest that would have otherwise been degraded or felled is, instead, preserved,"[141] as opportunities to mitigate climate change by reducing emissions and increasing sinks, while at the same time building ecological and social resilience to the impacts of climate change. Forests perform a wide range of ecological services that will be in ever greater demand in the face of global climate change: stabilization of local climate fluctuations, drought prevention, aquifer protection, preservation of pollinator populations, soil stabilization, and buffering from storms and floods.[142] Deforestation has a major impact on the health of local populations in addition to its indirect impact on global health through climate change.[143]

Some have expressed concerns, however, that Forest Carbon Offset (FCO) projects, if not carefully governed, could be manipulated to allow private industry to profit from projects that it would have undertaken anyway, even in the absence of a carbon trading mechanism that takes them into account.[144] Such manipulation could be accomplished by using the extra carbon credits generated to allow emissions from industrialized nations to continue unabated.[145] Incorporation of FCO projects into the Kyoto Protocol was intentionally circumscribed based on concerns that experts have classified into four main categories: leakage, permanence, additionality, and quantifiability.[146] Leakage refers to the concern that stakeholders who formerly relied on felling trees in a forest that becomes protected will simply move their operations elsewhere. For example, "a government may preserve one forest from planned

141 *Id.* at 56–57.

142 *Id.* at 57 (citing VALERIE KAPOS ET AL., UNEP, REDUCING EMISSIONS FROM DEFORESTATION: A KEY OPPORTUNITY FOR ATTAINING MULTIPLE BENEFITS 9–10 (2007), *available at* http://www.unep-wcmc.org/resources/publications/unep_wcmc%20RED%20Feb07.pdf; Stefano Pagiola et al., *Making Market-Based Mechanisms Work for Forests and People*, *in* SELLING FOREST ENVIRONMENTAL SERVICES: MARKET-BASED MECHANISMS FOR CONSERVATION AND DEVELOPMENT 261 (Stefano Pagiola et al. eds., 2002); David Freestone, *Foreword* to CLIMATE CHANGE AND FORESTS: EMERGING POLICY AND MARKET OPPORTUNITIES, at ix (Charlotte Streck et al. eds., 2008).

143 *See, e.g.*, Yaw A. Afrane et al., *Deforestation and Vectorial Capacity of* Anopheles Gambiae *Giles Mosquitoes in Malaria Transmission, Kenya* 14 EMERGING INFECTIOUS DISEASES 1533 (2008).

144 *See* Takacs, *supra* note 89, at 58–59.

145 *See id.*

146 *See* Imke Sagemüller, *Forest Sinks Under the United Nations Framework Convention on Climate Change and the Kyoto Protocol: Opportunity or Risk for Biodiversity*, 31 COLUM. J. ENVTL. L. 189, 195–96 (2006).

logging and instead offer timber concessions elsewhere [or] logging companies denied concession rights in one country may instead cut timber in a neighboring country."[147] Permanence refers to the concern that carbon sinks may be destroyed in the future as forests burn or are eventually encroached upon by other land uses, resulting in an eventual increase in emissions that offsets the temporary sink.[148] Additionality refers to the concern that some FCO projects would have been undertaken even in the absence of a carbon credit, based purely on profit motive. The result is a net increase in emissions as carbon credits awarded to projects that would have been undertaken anyway are used to avoid emission reductions in other sectors.[149] Finally, quantifiability refers to problems of measurement, monitoring, reporting, and verification associated with "calculating present and future carbon stored in forests, particularly under different climate change scenarios,"[150] as well as the difficulties of regulating a system that is more irregular in terms of its inputs and outputs than the transportation, energy, and industry sectors.

This is obviously an area where there is a significant threat that potential benefits may not be realized if the regulatory mechanism does not adequately take these special considerations into account. Incorporation of FCOs into the UNFCCC mitigation regime in the Reducing Emissions from Deforestation and Degradation (REDD) program was an important focus of the Copenhagen COP and the

147 Takacs, *supra* note 89, at 58 (citing Johannes Ebeling, *Risks and Criticisms of Forestry-Based Climate Change Mitigation and Carbon Trading*, *in* CLIMATE CHANGE AND FORESTS: EMERGING POLICY AND MARKET OPPORTUNITIES, *supra* note 142, at 43, 50–51); *see also* Philippe Cullet & Annie Patricia Kameri-Mbote, *Activities Implemented Jointly in the Forestry Sector: Conceptual and Operational Fallacies*, 10 GEO. INT'L ENVTL. L. REV. 97, 111 (1997); Gary C. Bryner, *Carbon Markets: Reducing Greenhouse Gas Emissions Through Emissions Trading*, 17 TUL. ENVTL. L.J. 267, 291, 296 (2004).

148 *See* Takacs, *supra* note 89, at 58 (citing PHILIPPE CULLET, DIFFERENTIAL TREATMENT IN INTERNATIONAL ENVIRONMENTAL LAW 124 (2007)); Sagemüller, *supra* note 146, at 195; KAPOS ET AL., *supra* note 142, at 9–10.

149 *See* Takacs *supra* note 89, at 58 (citing Revkin, *supra* note 115, at A1); Marisa Meizlish & David Brand, *Developing Forestry Carbon Projects for the Voluntary Carbon Market: A Practical Analysis*, *in* CLIMATE CHANGE AND FORESTS: EMERGING POLICY AND MARKET OPPORTUNITIES, *supra* note 142, at 311, 317; Sebastian M. Scholz & Martina Jung, *Forestry Projects Under the Clean Development Mechanism and Joint Implementation: Rules and Regulations*, *in* CLIMATE CHANGE AND FORESTS: EMERGING POLICY AND MARKET OPPORTUNITIES, *supra* note 142, at 71, 76–77.

150 Takacs, *supra* note 89, at 58 (citing Bryan Walsh, *Getting Credit for Saving Trees*, TIME, July 12, 2007, at 58); *see also* Kevin A. Baumert, Note, *Participation of Developing Countries in the International Climate Change Regime: Lessons for the Future*, 38 GEO. WASH. INT'L L. REV. 365, 381 (2006).

negotiations leading up to it. The Copenhagen Accord includes a paragraph on REDD[151] and an incomplete draft decision on the issue was also developed at the COP.[152] Given that this is a hotly contested issue among the environmental policy community, health policymakers have an opportunity to highlight the co-benefits for health of reforestation, and especially avoided deforestation, as a consideration that might tip the scale in favor of investing the considerable resources that will be required to regulate this area adequately if it is to be included in the mitigation regime.

Agricultural practices also play an important role in determining GHG emissions and carbon sinks. Agriculture accounts for roughly ten to twelve percent of global anthropogenic GHG emissions.[153] The link to deforestation, much of which is prompted by agricultural expansion, is also important for global emissions.[154] Production and use of nitrogen-based fertilizers, use of fossil fuels for agricultural production, animal waste management, and livestock enteric fermentation are all important sources of GHG emissions, which can be reduced by improvements in management practices.[155] At the same time, sustainable agricultural practices such as conservation tillage, cover cropping, and crop rotation practices can increase carbon sinks.[156] The IPCC has estimated that there is potential for mitigation in the agricultural sector of the equivalent of 5.5–6 gigatons of carbon dioxide per year by 2030.[157] For reference, total global emissions in 2000 were equivalent to forty-three gigatons of carbon dioxide.[158] The vast majority of this potential is in soil carbon

151 *See* Copenhagen Accord, *supra* note 8, ¶ 6 ("We recognize the crucial role of reducing emission from deforestation and forest degradation and the need to enhance removals of greenhouse gas emission by forests and agree on the need to provide positive incentives to such actions through the immediate establishment of a mechanism including REDD-plus, to enable the mobilization of financial resources from developed countries.").

152 U.N. Climate Change Conference COP 15, Copenhagen, Den., Dec. 7–15, 2009, *Outcome of the Work of the Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention*, FCCC/AWGLCA/2009/L.7/Add.6 (Dec. 19, 2009).

153 IPCC, MITIGATION OF CLIMATE CHANGE, *supra* note 27, at 499 (ch. 8).

154 FOOD AND AGRIC. ORG. OF THE UNITED NATIONS, ENABLING AGRICULTURE TO CONTRIBUTE TO CLIMATE CHANGE MITIGATION 2 (2009) [hereinafter FAO], *available at* http://unfccc.int/resource/docs/2008/smsn/igo/036.pdf.

155 *See id.* at 3; *see also* Gowri Koneswaran & Danielle Nierenberg, *Global Farm Animal Production and Global Warming: Impacting and Mitigating Climate Change*, 116 ENVTL. HEALTH PERSP. 578, 578 (2008).

156 FAO, *supra* note 154.

157 IPCC, MITIGATION OF CLIMATE CHANGE, *supra* note 27, at 500 (ch. 8).

158 *Id.* at 9 (summary for policymakers).

sequestration, which is the use of sustainable agricultural practices such as conservation tillage, cover cropping, and crop rotation to increase carbon sinks by increasing the amount of carbon sequestered in soil.[159] Reduction in methane emissions through improved management of livestock and rice farming practices, as well as reduction in nitrogen emissions through cropland management practices, round out the remaining potential for mitigation.[160]

The huge potential for agricultural mitigation is made even more attractive by the fact that it is a relatively low-cost approach. Many abatement options are cost neutral or even net profit positive and require relatively low capital investment, in part because the required technology is already well developed.[161] If agriculture industry players are allowed to trade the carbon credits they generate through low-cost interventions with players in other industries where mitigation is more costly, then the result will actually be profit for the agriculture industry. Thus, the incorporation of the agricultural sector into a GHG trading mechanism has the potential to subsidize, rather than impede, sustainable agricultural development, which in turn has significant benefits not only for climate change adaptation, but for meeting routine needs in the short term as well. Seventy-five percent of the world's poor live in rural areas in developing countries, and agriculture is the primary sector of the economy in most developing countries.[162] In addition to contributing to food security, sustainable agricultural development can promote poverty reduction in surrounding communities while preserving the resilience of agro-ecosystems.[163]

Despite these potential benefits, however, agricultural mitigation is even less far along in its incorporation into international climate governance than forest-based mitigation. Agriculture-based carbon sinks through soil carbon sequestration are not currently eligible for

159 The same practices that improve soil quality with decreased use of fertilizers can also increase the amount of carbon sequestered in soil. *See* Perry Miller et al., *Soil Carbon Sequestration in Agriculture: Farm Management Practices Can Affect Greenhouse Gas Emissions*, MONTGUIDE, Apr. 2004, *available at* http://msuextension.org/publications/AgandNaturalResources/MT200404AG.pdf.

160 FAO, *supra* note 154, at 1.

161 *Id.* at 1–2 (citing IPCC, MITIGATION OF CLIMATE CHANGE, *supra* note 27); MCKINSEY & COMPANY, PATHWAYS TO A LOW-CARBON ECONOMY: VERSION 2 OF THE GLOBAL GREENHOUSE GAS ABATEMENT COST CURVE (2009).

162 FAO, *supra* note 154, at 2.

163 *Id.* at 1–2.

CDM project status absent a very narrow research-based exception,[164] and the CDM itself makes up a relatively small part of the mitigation regime. Agricultural sequestration poses the same difficulties of permanence, leakage, additionality, and quantifiability[165] that the forestry and land use sector presents.[166] However, according to the U.N. Food and Agriculture Organization (FAO), the technology for measuring soil carbon sequestration is perhaps farther along than policymakers realize.[167] Furthermore, FAO notes that leakage is less likely to be a concern in the agricultural sector than in the forestry sector due to the likelihood that incorporation of agricultural mitigation operations is likely to be maintained and may even expand, rather than decrease, agricultural production.[168] Permanence, on the other hand, may be a greater concern in the agricultural sector than in the forestry sector, given that sustainable agricultural practices would need to be continued year after year to preserve the sequestration of carbon in soil and biomass.[169]

The greatest barrier to enabling agricultural mitigation approaches is not technology or cost to the agricultural sector, but rather the lack of financial and regulatory mechanisms that can accommodate the attributes that set the agricultural sector apart from other regulated sectors like transportation, energy, and industry. In addition to the concerns discussed above, the agricultural sector is also a difficult area for climate change mitigation because of the "sheer size of land areas under agriculture around the world (but at the same time this breadth of opportunity, which exceeds that of forestry, is part of its potential)[,] the variation in agroecosystems and farming systems, [and] the large numbers of farmers that would need to be involved."[170]

Unlike the forestry and land use sectors, incorporating agricultural sector mitigation opportunities into the international framework is far more complicated than simply scaling up the CDM. "Not only are many sources of agricultural mitigation not allowed under CDM, but its project-based and offsets approach does not generate the breadth

164 *Id.*

165 *See* Sagemüller, *supra* note 146.

166 *Id.*

167 FAO, *supra* note 154, at 3.

168 *Id.* at 5.

169 *Id.*

170 *Id.* at 2.

and scale of incentives that are needed."[171] Whereas mitigation in the forestry sector requires only that investors preserve forests or reforest degraded land, "[c]apturing the full potential of agricultural mitigation and its co-benefits requires widespread changes in agricultural production systems, which in turn requires changes in policy, institutions and technologies and a much broader approach by mitigation financing mechanisms."[172] In particular, innovative policy and financing solutions must: provide equal opportunities for both small-scale land holders and large-scale land owners; provide equal opportunities for rights to emissions; allow for effective incentivizing and enjoyment of co-benefits; allow tradable rights to emissions reductions to be held by land users, based on traditional as well as formal systems of property rights; make options for emissions crediting and trading flexible enough to allow for the diversity of mitigation approaches that might be appropriate in a particular local context; and ensure that expanded agricultural development that takes advantage of emissions trading opportunities conforms with international law for the protection of biodiversity.[173]

Perhaps the most important policy decision that would allow land use management and agricultural practices to play a major role in climate change mitigation with co-benefits for health is to what extent and in what ways developing countries are included in the post–Kyoto mitigation regime. This is indeed a key debate for determining the future of the successor mitigation regime, and was in many ways crucial to the downfall of the Kyoto Protocol. Much of the debate has focused on the reluctance of fully industrialized countries like the United States[174] and those in the European Union[175] to commit to binding targets unless the rapidly industrializing nations like China and India, important emerging competitors, are also bound. But there is another consideration in favor of incorporating developing countries, especially those that are rapidly industrializing, into the successor mitigation regime. The great majority of land use emissions are in the developing world, and seventy percent of the

171 *Id.* at 5.

172 *Id.*

173 *Id.* at 6.

174 *See* S. Res. 98, 105th Cong. (1997).

175 Although the European Union did in fact ratify the Kyoto Protocol, it has not met its targets under that agreement. *See* BALS, *supra* note 83. More recently, the European Union has indicated a willingness to make more significant reductions, but only if other major competitors do the same. *See id.*

huge potential for mitigation in the agricultural sector, most of which is based on increasing sinks, is in the developing world.[176] While forest and agricultural emissions and sink reductions account for a larger share of GHG concentrations than transportation and industrial sectors when considered globally, in industrialized countries they are far less significant. Some global health advocates, based on the premise that higher per capita income due to economic development is a critical determinant of health,[177] may fear that emissions limits will hinder development in the poorer countries of the world, and thus be harmful to global health.[178] However, it is important to understand that the mitigation strategies that will be particularly crucial at the national level if developing counties are included will have significant co-benefits for the health of local populations.[179] A massive expansion of the CDM might allow for better exploitation of mitigation opportunities in the developing world without binding developing countries to their own emissions reduction targets, though it would not necessarily be enough to induce industrialized countries to participate in a protocol that does not bind their rapidly industrializing competitors.

C. The Importance of Public Health Infrastructure to Adaptation

Human civilization has always adapted to gradual climate change via accommodation or migration, but what is unprecedented is the rapidity with which we must now adapt to climate change that is greatly accelerated by anthropogenic forcing.[180] What is new is "the conscious, planned, anticipatory approach" that has been proposed by the climate science and advocacy community.[181] One of the greatest challenges to adaptation planning is that while there is nearly universal scientific consensus about the fact that anthropogenically forced climate change is occurring, and that it will have significant

176 FAO, *supra* note 154, at 1.

177 *See, e.g.*, Lant Pritchett & Lawrence H. Summers, *Wealthier is Healthier*, 31 J. HUMAN RESOURCES 841 (1996).

178 *See, e.g.*, COMMISSION ON SOCIAL DETERMINANTS OF HEALTH, WORLD HEALTH ORG., CLOSING THE GAP IN A GENERATION: HEALTH EQUITY THROUGH ACTION ON THE SOCIAL DETERMINANTS OF HEALTH 66–68 (2008), *available at* http://whqlibdoc.who.int/publications/2008/9789241563703_eng.pdf.

179 *Id.* at 60–62.

180 INTEGRATION OF PUBLIC HEALTH WITH ADAPTATION TO CLIMATE CHANGE: LESSONS LEARNED AND NEW DIRECTIONS, *supra* note 97, at xvii.

181 *Id.*

impacts, the rate and degree of change and the severity of impacts is still subject to a great deal of uncertainty, particularly at the local level. The attempt to premeditate adaptation strategies, and thus enhance our preparedness for the impacts of climate change, touches on technological and policy advances addressing everything from retreat of physical infrastructure projects away from coastlines and building of structures to withstand more extreme weather events to developing agricultural technologies that can sustain food production in the face of harsher environmental conditions. In the health sector, adaptation to climate change is expected to require a variety of changes to health systems. Both health care delivery systems and public health infrastructure will come into play. Adaptation to climate change is anticipated to require increased capacity to provide access to adequate and affordable health care as well as capacity for early warning systems, disease monitoring and surveillance, natural disaster and public health emergency preparedness and response, and public education interventions.[182] Additionally, provision for basic survival needs, especially water and food systems management, will be crucial to our capacity to respond to the impacts of climate change. Particularly in the developing world, public health infrastructure and national health law have a long way to go to rise to the challenges that climate change is likely to pose.

In addition to creating novel threats to health and shifting the geographic scope of existing threats, climate change will also act as an intensifier, dramatically increasing the magnitude of preexisting problems ranging from poverty, conflict, and hunger to infectious and chronic disease burdens.[183] Some health adaptation measures will likely be aimed at confronting new risks posed by climate change, at least at the local level, such as preparation for monitoring and control of malaria-carrying mosquitoes at higher altitudes where populations have not previously been exposed, or response to new diseases that might emerge in the context of changed environmental conditions. Most adaptations in the context of global health, however, are likely to be "no-regrets strategies."[184] Improvements of public health systems focusing on accessible basic health care facilities, clean water and sanitation, and disease control programs may be motivated in part

182 *Id.* at xviii.

183 *See supra* notes 13–15 and accompanying text.

184 INTEGRATION OF PUBLIC HEALTH WITH ADAPTATION TO CLIMATE CHANGE: LESSONS LEARNED AND NEW DIRECTIONS, *supra* note 97, at xviii.

by climate change concerns, but are likely to have significant benefits regardless of whether climate, in fact, has the impact that scientists anticipate. These strategies have the potential to enhance the ability of public health systems to respond to the routine threats they already face, even as those threats intensify.

The public health and global health communities have a long history of managing new threats to population well-being. In many ways, the health advocacy community is more experienced with the type of questions presented by climate change adaptation than the environmental advocacy community. Whereas international environmental governance has typically been concerned with regimes that *limit* the actions of state, and consequently industrial players, global health governance has been more focused on *promotion* of health and well-being through affirmative duties. Adaptation necessarily builds more on the latter sort of inquiry, and thus is in some ways far afield of the typical focus on environmental regulatory bodies. Health advocates bring their experience in evaluating the success and investigating the failure of various types of intervention, as well as what they have learned through their experiments with a variety of positive law and policy tools.

Although health advocates have been regrettably late to the climate governance table, global health voices are increasingly speaking of climate change as one of the most important threats to worldwide human well-being. In a recent resolution, the World Health Assembly committed to providing member states with support and advice regarding health impacts of climate change and adaptation approaches independently of the UNFCCC, and also to seeking a greater role within the UNFCCC.[185] The UNFCCC Secretariat has been criticized for not adequately "supporting processes outside of the Convention which have particular expertise in areas that are key to adaptation."[186] One issue among many under consideration by the UNFCCC Ad-hoc Working Group on Long-Term Cooperative Action (AWG-LCA) and the Nairobi Work Programme (NWP) is whether a permanent adaptation body or expert group should be established under the UNFCCC.[187] An adaptation body or panel would create a procedural

185 Sixty-First World Health Assembly, *supra* note 11.

186 HARMELING, *supra* note 106, at 6.

187 *Id.* at 42–44. Developing countries largely support the establishment of an adaptation body, urging that it would allow for better integration of expertise specific to the varied areas touched on by adaptation policy. *Id.* Several industrialized countries have

opportunity for health experts, among others, to play a more active role in climate adaptation governance.

Another issue under debate in the UNFCCC AWG-LCA that has implications for global health policy is whether adaptation assistance from wealthy to developing countries should be mainstreamed with Official Development Assistance (ODA). Developed nations have increasingly called for the integration of adaptation into general development policy and planning as a precondition for funding.[188] Integration of policy is not particularly controversial, and most agree that it is in fact crucial to the development of coherent adaptation strategies at the national level.

> Adaptation is not simply a matter of designing projects or putting together lists of measures to reduce the impacts of climate change. A national policy response would increase resilience to climate vulnerability and change and should be anchored in a country's framework for economic growth and sustainable development and integrated in its poverty reduction strategies.[189]

The controversy arises because developing nations have perceived this call for mainstreaming as an indication that developed countries will shirk their responsibility for compensating developing countries for the impacts of anthropogenically forced climate change. The majority of developed countries have indeed argued that "[b]ecause the costs of adaptation . . . provide largely local benefits, [are] difficult to distinguish from 'regular' development, [are] suspected to be large, and smacked of compensation awarded for damages,"[190] substantial funding should not be allocated for adaptation. Instead, they suggested that ODA will play an important role in financing adaptation measures. Given that most countries already fall far short of meeting their ODA commitments,[191] developing countries insist that "adaptation is not funded as general [ODA], but as a kind of

expressed opposition to the idea, noting that there are ways to make use of existing bodies outside of the UNFCCC rather than taking on the expense of creating a new adaptation body. *Id.*

188 *Id.* at 21–22.

189 El-Ashry, *supra* note 134, at 3–4.

190 *Id.* at 4.

191 *See, e.g.*, ONE, THE DATA REPORT 2009: MONITORING THE G8 PROMISE TO AFRICA, EXECUTIVE SUMMARY, *available at* http://www.one.org/international/datareport2009/downloads.html.

compensation for extra costs that are imposed on them by those who contribute the most to anthropogenic greenhouse gas emissions."[192]

The debate highlights that what may seem on the surface to be a win-win or no regrets situation, where funds invested for climate change adaptation also have multiple co-benefits and are thus more cost effective, may belie an attempt to shift funds from ODA to climate change adaptation without actually increasing assistance overall. Fundamental principles of international environmental law support adaptation-only funding as opposed to ODA mainstreaming. Both the "polluter pays" principle established in the Rio Declaration[193] and the "common but differentiated responsibility" principle, which forms the legal foundation of the UNFCCC,[194] support exactly the compensatory character of adaptation funding to which developed countries have objected. Furthermore, given that ODA already falls far short of what is needed in the developing world, the innovative financing structure of the Adaptation Fund is a promising development.[195] Global health advocates should promote the integration of climate adaptation considerations into development plans, but should also advocate strongly for building upon the Adaptation Fund's financing mechanism to allow for significantly higher funding, rather than mainstreaming of adaptation funding into ODA.

"Public health prevention and climate change adaptation share the goal of increasing the ability of nations, communities, and individuals to effectively and efficiently cope with challenges and changes.

192 HARMELING, *supra* note 106, at 22.

193 U.N. Conference on Env't & Dev., Rio de Janeiro, Braz., June 3–14, 1992, Rio Declaration on Environment and Development, princ. 10, U.N. Doc. A/CONF.151/26 (Aug. 12, 1992) ("National authorities should endeavor to promote the internalization of environmental costs and use of economic instruments, taking into account the approach that the polluter should, in principle, bear the costs of pollution . . . ."). *See also* Cass R. Sunstein, *Of Montreal and Kyoto: A Tale of Two Protocols*, 31 HARV. ENVTL. L. REV. 1, 54 (2007) (describing GHG pollution as a kind of tort, where polluters who have gained economically from their pollution ought to pay for the damage they have caused).

194 UNFCCC, *supra* note 70, at art. 3 ("The [p]arties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country [p]arties should take the lead in combating climate change and the adverse effects thereof.").

195 *Cf.* Anthony Clunies-Ross, *Development Finance: Beyond Budgetary "Official Development Assistance,"* 26 MICH. J. INT'L L. 389, 393 (2004) (stating that financing approaches that go beyond official development assistance, including internationally coordinated levies, are necessary to provide sufficient funding for development).

Indeed, that is what is meant by adaptation to an external stress."[196] Emphasis on climate change as a fundamental transformation of our environment with important consequences for health has the potential to motivate the additional political will needed to improve global health infrastructure in ways that will make health systems more resilient in the face of climate change while also building capacity to handle more routine needs. Many potential climate change adaptation projects, such as the development of better disease surveillance and response capacity, improvements in sanitation and protection of food and water security, and the strengthening of natural disaster preparedness and response capabilities, look a lot like traditional international health initiatives.

Rights and responsibilities with respect to adaptation, currently being negotiated under the auspices of the UNFCCC, have the potential to create new opportunities to focus on the basic survival needs of the world's least healthy people[197] in ways that previous efforts at international cooperation with respect to health have not. This is due to a basic difference between the motivation for traditional means of international cooperation with respect to health and the motivation driving cooperation on adaptation. The recently revised International Health Regulations, for example, establish obligations for international cooperation that are largely driven by the threat of transboundary spread of disease.[198] Some critics have suggested that the history of these regulations indicates that they are ultimately motivated by the threat of spread from the developing world to the industrialized world.[199] Focus on self-interest as a motivation for wealthy countries' willingness to cooperate on global health

196 Gary Yohe & Kristie L. Ebi, *Approaching Adaptation: Parallels and Contrasts Between the Climate and Health Communities*, *in* INTEGRATION OF PUBLIC HEALTH WITH ADAPTATION TO CLIMATE CHANGE: LESSONS LEARNED AND NEW DIRECTIONS, *supra* note 97, at 18, 18.

197 *Cf.* SVEN HARMELING ET AL., MAKING THE ADAPTATION FUND WORK FOR THE MOST VULNERABLE PEOPLE (2008) *available at* http://www.germanwatch.org/klima/adfund08.pdf.

198 *See* David P. Fidler, *From International Sanitary Conventions to Global Health Security: The New International Health Regulations*, 4 CHINESE J. INT'L L. 325, 336 (2005).

199 *See id.*; *see also* Oyewale Tomori, Presentation prepared for the Forum on Microbial Threats Public Workshop: IHR and Movement of Pathogens in a Globalized World (Dec. 16–17, 2008), http://veterans.iom.edu/~/media/Files/Activity%20Files/PublicHealth/MicrobialThreats/Tomori.ashx (addressing perception of the motivation behind the IHR as an obstacle to implementation in developing countries).

initiatives necessarily plays a role in dictating the priorities that will be addressed by that cooperation. This emphasis leads, for example, to prioritization of emerging diseases that have the potential for rapid spread over reducing more burdensome impacts from relatively easily addressed threats such as parasitic or diarrheal illness.[200] The health impacts of climate change are, for the most part, not the sort of threats that are likely to move rapidly from the developing world to the industrialized world. It is certainly possible that changed climate conditions could foster the emergence of new viruses with the potential for global spread. It is more likely, however, that most threats, including the intensification of diarrheal illness, the gradual latitudinal and altitudinal spread of vector-borne illness, greater intensity of natural disasters, and the effects of insecurity and water stress more generally, will not be of the sort that prompt self-interested action by wealthy countries to build improved health infrastructure in the developing world. The adaptation regime currently under negotiation, however, is not prompted by the transboundary nature of the impacts of climate change as much as it is by the transboundary nature of the causes. This might mean that adaptation cooperation faces an uphill battle. But, if it is successful, both the tie between adaptation cooperation for the benefit of developing countries and the willingness of developing countries to participate in a mitigation regime might be the crucial key to that success, then it will allow for international cooperation on health threats that have previously been neglected.

IV
MOVING THE DEBATE FORWARD

As the focus of the UNFCCC has broadened to include greater consideration of adaptation to the impacts of climate change, communities beyond the traditional boundaries of environmental regulatory policymaking have begun to realize the extent to which their interests are implicated by the international response to climate change. Indeed, adaptation requires a very different set of law, policy, and governance tools than environmental policymakers have

200 *See, e.g.*, Peter J. Hotez et al., *Control of Neglected Tropical Diseases*, 357 NEW ENG. J. MED. 1018, 1018–19 (2007) (comparing the impacts of neglected tropical diseases, most of which are preventable through environmental health interventions such as clean water and sanitation, with those of emerging acute infections such as Ebola virus and avian influenza).

traditionally employed in their mitigation efforts,[201] and it may be that policymakers from other sectors, including global health, are better suited to the effort. In recent years, the UNFCCC has shown a greater willingness to reach out to the health, agricultural, and land use sectors for expertise and policymaking guidance on mitigation policy as well as adaptation. The challenges posed by such an all-encompassing scope for international cooperation are indeed considerable, but so are the opportunities. Consideration of the co-benefits of particular mitigation opportunities, for health as well as for sustainable development more generally, should play a crucial role in weighing the various policy options currently under consideration. By prompting a recalculation of the costs and benefits, bringing these broader considerations into account may serve to move the debate forward in a way that increases the likelihood that the international community will take meaningful action on climate change as the international community continues to negotiate and implement a post–2012 climate agreement

201 *Cf.* Benjamin J. Richardson & Stepan Wood, *Environmental Law for Sustainability*, *in* ENVIRONMENTAL LAW FOR SUSTAINABILITY 1, 2 (Benjamin J. Richardson & Stepan Wood eds., 2006) (discussing the command and control approach traditionally applied to environmental problems).