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Climate Change: Human Health, the Developing World and the Global Response

Cole James Kriett
Augsburg University

Climate Change: Human Health, the Developing World and the Global Response

By

Cole James Kriett

Holly Levine, MD

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Introduction

Climate change over the last two centuries has accelerated to rates faster than any other period in the past thousand years.[1] Since the late 1950's an average global temperature increase of 0.6° C and 10-20 cm rise in sea level have been reported.[2] A few effects of the rising temperatures include but are not limited to: acidification of oceans, soil degradation, loss of biodiversity, desertification, loss of productivity in agricultural land, and reduced-fresh water resources. This reduction in fresh water resources is forecasted to place 64 percent of the world's population in water stressed basins.[3] To put the severity of this global issue into perspective, an estimated 150,000 lives are claimed annually from climate change. In addition, these deaths are disproportionately distributed among the developing world (Figure 1).[4]

Human life is dependent on the dynamics of the Earth's climate system. Extreme weather events – storms, heat waves, cyclones, fires, and floods – are the immediate health risks associated with climate change. A wider spectrum of heath consequences such as food insecurity, water insecurity, mental health ramifications, non-communicable diseases, and various infectious diseases will also be seen.[5] These time sensitive issues are being confronted at a national level, being they have the resources to do so, and also internationally.

The United Nations Environment Programme (UNEP) is the current leading global environmental authority. UNEP sets global environmental agendas, promotes the implementation of sustainable development within the United Nations (UN) system and is an advocate for the global environment. The three areas that UNEP is focusing on are climate resilience, low-emission growth, and reducing emissions from deforestation and forest degradation in developing countries (REDD +).[6] In spite of UNEP and other programs alike, sustainability will

need to be achieved through a timely response from the global community.

This paper will explore the hypothesis that without an adequate global response to the rapidly changing climate there will be increased negative health effects disproportionately affecting the developing world. Through a review of the literature, this author will explore the global health impact of climate change and analyze the disproportionate effects and barriers developing countries will face in years to come. Current global responses and policies set forth will be examined for adequacy in curbing this accelerated rate in negative human health effects. This paper will explore the human health impact of climate change and stress the importance of sustainability and universal responsibility in cushioning the effects on vulnerable populations.

Background

Infectious Disease

Humidity, rainfall, temperature, maturation and viability of the pathogen, range and abundance of reservoir or intermediate species, and the vector organism can all have a role in the complexity of a single infectious disease.[5] Vectors, generally insects, are living organisms that can transmit infectious diseases. Insect vectors, such as ticks, flies, fleas, and mosquitos are all affected by climate change.[1,4,7] In the case of the mosquito, the best known disease vector, a warmer climate presents a more favorable environment for the survival and completion of the life cycle.[1,4] In addition, the regional warming is expanding the geographical range and causing the vectors to operate in a more active state. In the case of malaria, this could allow one mosquito in these ideal conditions to have more bites per day thus potentially infecting more individuals.[5,7]

Except for regions of the world that are permanently covered by ice, mosquitos are found worldwide. Vector borne diseases can be expressed in a range of ways, from long-term gradual changes to short-term epidemics.[8] If global temperatures rise by the expected 2–3° C by the year 2100, the epidemic potential of the mosquito population will increase two-fold in tropical regions and over 100-fold in temperate regions.[9] With the World Health Organization (WHO) reporting 212 million new cases of malaria and 429,000 deaths in 2015 alone, this possible increase in epidemic potential cannot be overlooked.[10] In addition, this increase in malaria risk will be superimposed upon population growth, effectiveness of control methods, and socioeconomic development which could seriously affect human health in the next century.[5]

Non-Communicable Disease

Changes to the Earth's biophysical system will extend and exacerbate the rates of not only infectious disease, but also non-communicable diseases such as cardiovascular disease and lung disease. As temperatures continue to rise so will heat-related mortality and morbidity from overloading the cardiovascular and respiratory systems, especially individuals who are already at risk for complications, who potentially became at risk due to climate change related causes. Extreme temperatures and higher ground-level air pollutants are the direct result of climate change and have both been directly linked to increased risk of cardiovascular disease.[11] Several environmental air pollutants, which include carbon monoxide, oxides of nitrogen, ozone, particulate matter, and lead are associated with increased mortality and hospitalization due to cardiovascular disease.[12] This compromised outdoor air quality will also directly affect the respiratory system, contributing to increased acute respiratory tract infections, chronic pulmonary disease hospitalization, and lung disease mortality.[11]

Along with both infectious disease and non-communicable diseases, mental health disorders are under the influence of climate change. The direct correlation between stress and anxiety and the increase in negative human health impacts, increased competition over scarce resources, and even the fear or perception of climate change may threaten mental health. The populations exposed to extreme weather events, such as tsunamis, hurricanes, tornados, floods, fires, and droughts may experience more immediate mental health consequences.[11] Reported by Coker et al., moderate or severe symptoms of post-traumatic stress disorder were experienced by 63 percent of Hurricane Katrina evacuees. Being that the most common non-communicable diseases accounted for 60 percent of the global annual deaths in 2004, climate change adaptation strategies are needed in order to create living conditions that reduce the risk of non-communicable diseases.[13]

Extreme Weather Events

The frequency, intensity, spatial extent, and duration of climate-related extreme weather events have been increasing since 1950.[14] This increase in frequency of these extreme weather events – storms, hurricanes, droughts, rain-related floods – is due to the climate system acquiring more energy from the latent heat of increased water vapor and higher average air temperatures. The fourth assessment report (AR4), a comprehensive assessment of the physical science of climate change released by the intergovernmental panel on climate change (IPCC), includes higher minimum temperature, higher maximum temperature, more hot days, and fewer cold days as “virtually certain”. The report also stated an increase in the intensity and length of warm spells, heave waves, and precipitation was “very likely”. Lastly the AR4 projected droughts, changes in tropical cyclone activity, and an increase in extreme sea level as “likely”.[1]

Roughly 32 million people fled their homes because of catastrophes in 2012. The estimated 1-meter rise in sea level by the end of the century could impact anyone living within 60 miles of a shoreline, one third of the world's population, and 13 of the world's 20 largest cities.[11] An increased mortality due to injuries would be the immediate consequence to these weather events, while in the long term there could be an effect on water quality and availability. This reduction in potable water could result from droughts or flooding leading to contamination through chemicals or pathogens.[1,4] Moreover, introduction of new pathogens, facilitated by higher temperatures, may result in increased need for pesticides and fertilizers further polluting these finite fresh water resources.[1]

During times of drought, rises in displacement, job loss, anxiety, depression, and suicide rates are seen.[11] These issues will only be inflamed by food systems that are currently and increasingly affected by climate change. Contributions to this include higher temperatures, increasing frequency of flooding, acidification of oceans, and rising sea levels.[4] In a study from the International Rice Research Institute in the Philippines, a 10 percent reduction in rice yields was seen with a 1° C rise in nighttime temperature.[15] The loss of crops or livestock will precipitate profound consequences on the population causing malnutrition, and subsequent complications in childhood development.[1] Projections of future climate suggest these changing patterns of weather events will have a significant impact on human health.[7] In addition, climate change will exacerbate water and food insecurity in many regions leading to inevitable adverse health consequences, especially in developing countries.[5]

Methods

This research was conducted through a review of the literature. A PubMed search using

the search operators “climate change”, “global warming”, “human health”, “developing countries” was used, and articles were filtered based on relevance and date of publication. From initial studies, each reference section was reviewed and subsequent articles were found. More specific searches using key terms “infectious disease”, “malaria”, and “vector borne diseases” were used. Only studies from peer-reviewed journals were included in the paper. A relevant interview was conducted with Dr. Leonel Argüello, epidemiologist and president of the Nicaraguan association of general practitioners. Government websites were utilized to obtain background information on global policies on climate change, UNEP, as well as finding direct sources.

Discussion

Developing World

Many of the health impacts of climate change are a distinct threat to poverty stricken countries. Vector borne diseases alone pose a significant cause of death, strain on socioeconomic development, disease burden and health inequity, and as a strain on health services with the mortality rate derived from vector borne diseases almost 300 times higher in developing nations when compared to developed countries.[16] In addition, the 429,000 deaths from malaria and 212 million new cases in 2015 are estimated to have occurred in fewer than 15 countries.[11] These statistics further confirm the disproportionate effect of vector borne diseases on these vulnerable populations, not even considering the potential ramifications of extreme weather events.

Climate aside, the current projected 10 leading causes of disease globally indicates a predominance of non-communicable diseases, with rapid growth in low and middle-income countries.[11] This projection was defended during an interview with Dr. Leonel Argüello. He

stated that over his 30 plus years of practice in a developing country he has noticed and connected with climate change, an increase in not only vector borne diseases, but also non-communicable diseases.

People living in developing countries face a higher burden of natural disasters because they are directly affected by environmental degradation and have a decreased ability of defending themselves from their immediate environment.[1] This effect is supported by the fact that in many of these regions the increase in population size and density is forcing people to relocate into areas where the tempo of extreme weather events is greater.[6] These areas might have limited access to water in addition to the exacerbating affect of climate change further increasing water insecurity, which also has direct affects on food availability. However, this brings up the important idea that climate change should not be considered in isolation from other global environmental stresses; promotion of economic growth, poverty elimination, and protection of cultural resources. Accordingly, future policy-makers need to view climate change as more of a comprehensive challenge of sustainable development.

UNEP Response to Climate Change

UNEP is the leading organization for coordinating environmental matters on sustainable development between the UN and global leaders. The organization is operating through three main task areas. First, climate resilience is achieved through supporting countries using ecosystem-based approaches. Next, low emission growth is being reached through several techniques: reduction in greenhouse gas emissions, adoption of renewable energy, air pollution reduction, and scaling up energy efficiency measures. Finally, UNEP enables countries through REDD+ to capitalize on investment opportunities that reduce greenhouse gas emissions from

forest degradation and deforestation with adequate environmental and social safeguards.[6]

During the 2014-2015 biennium, UNEP reported 70 percent of expected accomplishments had been achieved in addition to 79 percent of targeted indicators (Figure 2 & 3). UNEP enabled 20 countries to implement these ecosystem-based adaptations, as well as increased availability of micro financing - converting $600 billion worth of assets to carbon-free energy. With current efforts to lowering atmospheric concentrations of greenhouse gases (GHGs), UNEP's 2015 emissions gap report showed 11 gigatonnes of CO_2 emissions could be cut with current efforts by 2030. While these current efforts will only reach half the amount of reduction needed to have a likely chance of achieving the 2100 goal of staying below a 2° C global temperature rise, this will still improve urban air quality thus decreasing respiratory and cardiovascular diseases.[6,11] Goals set by UNEP in their REDD + program aim to reduce the rate of forest loss by 2020 and end natural forest loss by 2030, which will not only have a large impact on global emissions, but on dietary diversity and access to medicinal substances.[6,11,8] These accomplishments and goals are primarily being met through mitigation and adaptation (Fig. 4). McMichael and Lindgren have also come to the conclusion that mitigation and adaptation are the primary methods for repressing the advances of climate change; therefore, limiting the future human health consequences with the potential of "bonus" health co-benefits (Fig. 4).[5] Although these strategies and policies will be important to the containment of climate change, the developed world taking responsibility will be essential.[7]

Universal Responsibility of the Developed World

Developing regions of the world have been dramatically affected by climate change in comparison to developed countries.[5] The developed world has a moral responsibility to the

poorest nations for the potential ramifications they are likely to experience because of our lack of control on our excess energy consumption. A stark contrast in CO_2 emissions, reported by the United Nations Millennium Development Goals in 2006, reflected this lack of control with developed regions producing 78 percent of the total global emissions.[7] Advancements made through international programs like UNEP are making strides in halting the buildup of GHGs in the atmosphere. With the understanding that there is a significant temporal lag between emission reduction and slowing in the rate of warming, efforts need to be increased and brought into the international spotlight more than ever.

In addition to programs like UNEP, the engagement of the health sector towards the increasing pollution related diseases and extreme weather events is vital. The health sector can help by developing skills and knowledge in adaptation and preventative programs, strengthening primary health care, improving emergency preparedness, placing special attention on vulnerable populations, and helping forecast future health risks. However, this adaptation to climate change and variability will depend on the level of health infrastructure in the affected region.[8] Particularly in developing regions of the world where climate change will exacerbate existing health inequities between and within countries.[11] Placing health at the heart of climate change is the responsibility of human beings everywhere. By coming together we have the potential to have an unrivalled impact on the health of the human population and global public health.[1]

Sustainability is the key to maintaining the Earth's ecological systems. Human health and wellbeing will be jeopardized if these systems decline. The state of human health should be the central consideration in this transition towards sustainability.[17] Action needs to be taken now, but also in a coherent and sensitive manner. Policies and programs in energy use, urban planning, and agriculture may generate major co-benefits for the people and the planet. These actions have

the potential to lessen poverty and improve social equity, so nations will be able to resist current climate change, avoid further damage, and continue to develop with sustainability in mind.[11]

Conclusion

Climate change is an urgent issue that must be confronted in order to continue living within the Earth's limits.[17] An immediate response by the global community is necessary to prevent a point of no return. The increasing range of deadly diseases, like malaria, and rapidly rising rates of non-communicable diseases are among many reasons why this issue is time sensitive. Developing a mandatory international treaty, enacting local legislation, practicing environmental stewardship, and increasing climate change awareness are all important steps to be taken in years to come. We must also continue to obtain the answers of how climate change will affect our most vulnerable populations and do what is needed to protect them.[7]

Developing nations face the greatest burden of climate sensitive human health impacts while also having the lowest capacity to adapt to these changes. Addressing these global ethical challenges cannot be accomplished without supporting organizations like UNEP or the IPCC. However, these organizations cannot achieve global sustainability alone. Human beings collectively taking responsibility for climate change will be vital to this process. Finally, acting as universally responsible citizens of the world will allow this planet to continue to be habitable for future generations to come.

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Appendices

Region	CVD		Diarrhoea			Malaria			Floods			
	Mortality*	Risk‡	Mortality*	Disease†	Risk‡	Mortality*	Disease†	Risk‡	Mortality*	Disease†	Risk‡	
											Inland	Coastal
AFR-D	1	1.007	5	154	1.08	5	178	1.02	0	1	1.36	1.64
AFR-E	1	1.005	8	260	1.08	18	682	1.14	0	3	1.48	1.18
AMR-A	0	1	0	0	1	0	0	1.51	0	4	4.93	1.19
AMR-B	1	1.004	0	0	1	0	3	1.15	1	67	2.13	2.27
AMR-D	0	1.005	1	17	1.02	0	0	1.08	0	5	1.78	4.64
EMR-B	0	1.003	0	14	1	0	0	1	0	6	2.67	1.75
EMR-D	1	1.003	8	277	1.09	3	112	1.29	1	46	3.05	3.91
EUR-A	0	0.999	0	0	1	0	0	1	0	3	3.55	1.14
EUR-B	0	0.999	0	6	1.01	0	0	1	0	4	1.82	6.31
EUR-C	0	0.998	0	3	1	0	0	1.48	0	1	2.35	1.04
SEAR-B	1	1.007	1	28	1	0	0	1	0	6	1.79	1.39
SEAR-D	7	1.007	22	612	1.09	0	0	1.01	0	8	1.12	1.04
WPR-A	0	0.999	0	0	1	0	0	1.48	0	1	1.76	1.04
WPR-B	0	1	2	89	1.01	1	43	1.42	0	37	1.62	1.05
World	129	-	47	1,459	-	27	1,018	-	2	193	-	-

Region	Malnutrition			All causes		Total deaths per million	Total DALYs per million
	Mortality*	Disease†	Risk‡	Mortality*	Disease†	Mortality*	Disease†
AFR-D	8	293	1.02	19	626	66.83	2,185.78
AFR-E	9	323	1.02	36	1,267	109.4	3,839.58
AMR-A	0	0	1	0	4	0.15	11.85
AMR-B	0	0	1	2	71	3.74	166.62
AMR-D	0	0	1	1	23	10.28	324.15
EMR-B	0	0	1	1	20	5.65	147.57
EMR-D	9	313	1.08	21	748	61.3	2,145.91
EUR-A	0	0	1	0	3	0.07	6.66
EUR-B	0	0	1	0	10	1.04	48.13
EUR-C	0	0	1	0	4	0.29	14.93
SEAR-B	0	0	1	2	34	7.91	117.19
SEAR-D	52	1,918	1.17	80	2,538	65.79	2,080.84
WPR-A	0	0	1	0	1	0.09	8.69
WPR-B	0	0	0.99	3	169	2.16	111.36
World	77	2,846	-	166	5,517	27.82	925.35

*Estimated mortality in thousands attributable to climate change in 2000 (compared to baseline climate of 1961–1990).
†Estimated disease burden in thousands of DALYs attributable to climate change in 2000.
‡Projected changes in relative risk for 2030.
§Heat-related deaths without subtracting potential reductions in cold-related deaths; this value was therefore not included in the aggregate estimates of mortality due to climate change.
The data in Table 1 are taken from ref. 57. The region key is taken from ref. 57. AFR-D: Algeria, Angola, Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Comoros, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Mauritius, Niger, Nigeria, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Togo.
AFR-E: Botswana, Burundi, Central African Republic, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.
AMR-A: Cuba, Canada, United States of America.
AMR-B: Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.
AMR-D: Bolivia, Ecuador, Guatemala, Haiti, Nicaragua, Peru.
EMR-B: Bahrain, Cyprus, Iran, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, United Arab Emirates.
EMR-D: Afghanistan, Djibouti, Egypt, Iraq, Morocco, Pakistan, Somalia, Sudan, Yemen.
EUR-A: Andorra, Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, the Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom.
EUR-B: Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Kyrgystan, Poland, Romania, Slovakia, Tajikistan, Macedonia, Turkey, Turkmenistan, Uzbekistan, Yugoslavia.
EUR-C: Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Russian Federation, Ukraine.
SEAR-B: Indonesia, Sri Lanka, Thailand.
SEAR-D: Bangladesh, Bhutan (Democratic People's Republic of), Korea, India, Maldives, Myanmar, Nepal.
WPR-A: Australia, Brunei, Darussalam, Japan, New Zealand, Singapore.
WPR-B: Cambodia, China, Cook Islands, Fiji, Kiribati, Lao, Malaysia, Marshall Islands, Micronesia, Mongolia, Nauru, Niue, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, Vietnam.

Figure 1: Global burden of climate-change-attributable disease[4]

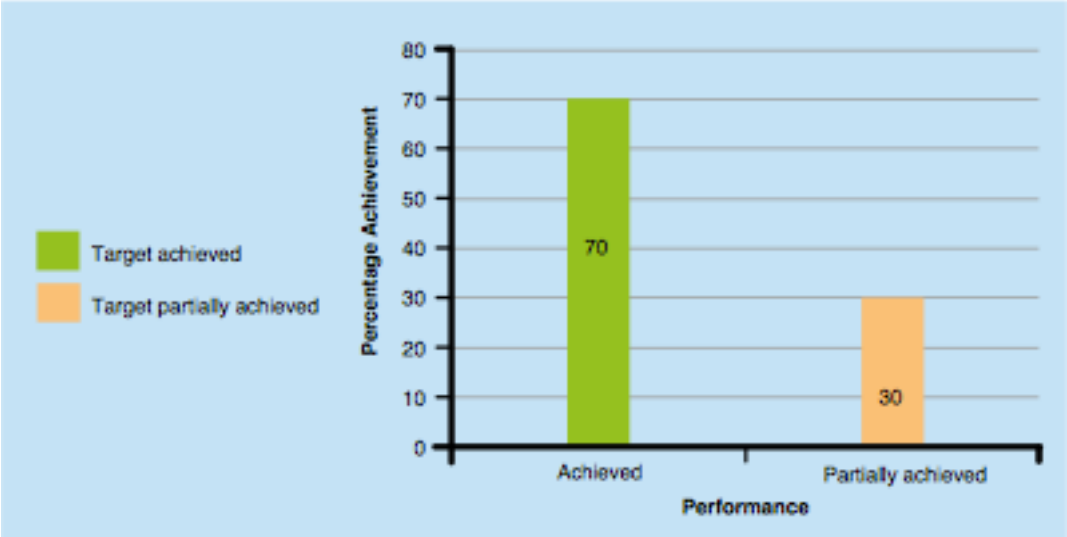

Figure 2: Overall performance of UNEP[6]

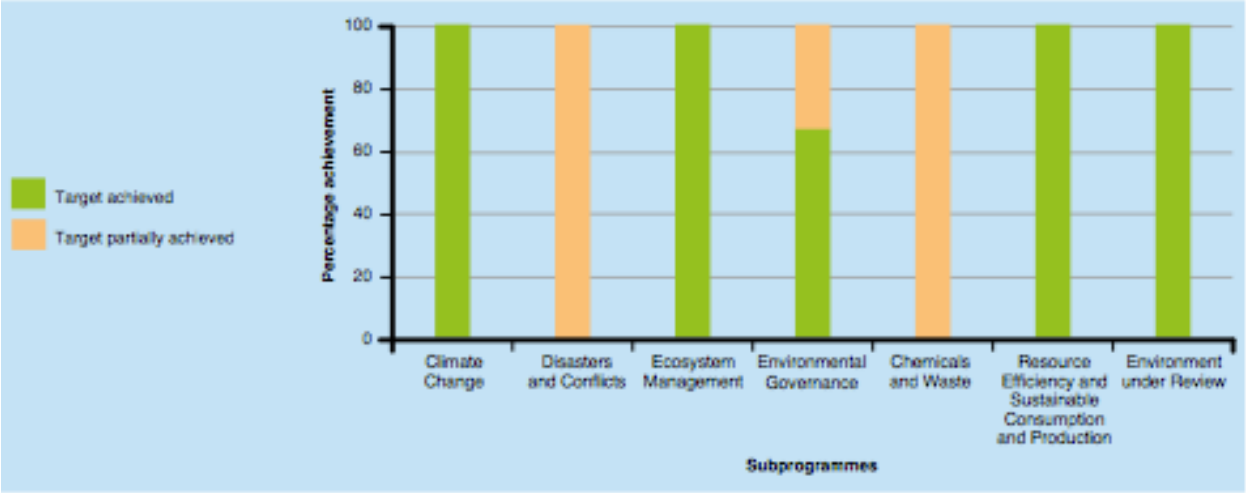

Figure 3: UNEP's reported status of achievement for expected accomplishments in 2014-2015 biennium[6]

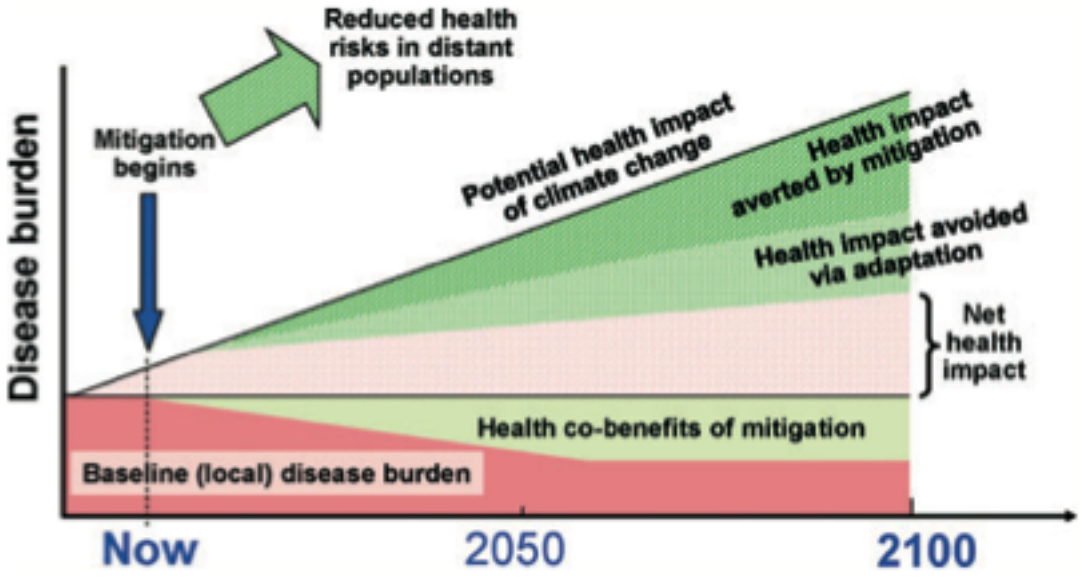

Figure 4: Potential human health benefits from limiting climate change[5]

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