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GLOBAL HEALTH GOVERNANCE IS AN OPEN ACCESS, PEER-REVIEWED, ONLINE JOURNAL THAT PROVIDES A PLATFORM FOR ACADEMICS AND PRACTITIONERS TO EXPLORE GLOBAL HEALTH ISSUES AND THEIR IMPLICATIONS FOR GOVERNANCE AND SECURITY AT NATIONAL AND INTERNATIONAL LEVELS.

THE JOURNAL PROVIDES INTERDISCIPLINARY ANALYSES AND A VIGOROUS EXCHANGE OF PERSPECTIVES THAT ARE ESSENTIAL TO THE UNDERSTANDING OF THE NATURE OF GLOBAL HEALTH CHALLENGES AND THE STRATEGIES AIMED AT THEIR SOLUTION. THE JOURNAL IS PARTICULARLY INTERESTED IN ADDRESSING THE POLITICAL, ECONOMIC, SOCIAL, MILITARY AND STRATEGIC ASPECTS OF GLOBAL HEALTH ISSUES.

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SPECIAL ISSUE:
CLIMATE CHANGE AND GLOBAL HEALTH GOVERNANCE

TABLE OF CONTENTS

GLOBAL
HEALTH GOVERNANCE

CLIMATE CHANGE AND GLOBAL HEALTH SECURITY: AN OVERVIEW OF THE SCOPE AND ISSUES

Robert L. Ostergard, Jr. and Nicholas Seltzer

The links between climate change and health security have been under investigation for decades. However, at its core, linking climate change to health security faces a number of complex obstacles, most of which are linked to the indirect nature and the temporal challenges in the relationship. This relationship has significant ramifications for people and states that include the impact on bioorganisms and viral transmission, agriculture and food supplies, and social interactions such as poverty, migration, and conflict. This article provides an overview of the complex relationships that emerge from the climate change and health security nexus, while serving as an introduction to the wide-ranging articles that appear in this volume. We conclude with policy recommendations and implications of the climate change and health security relationship.

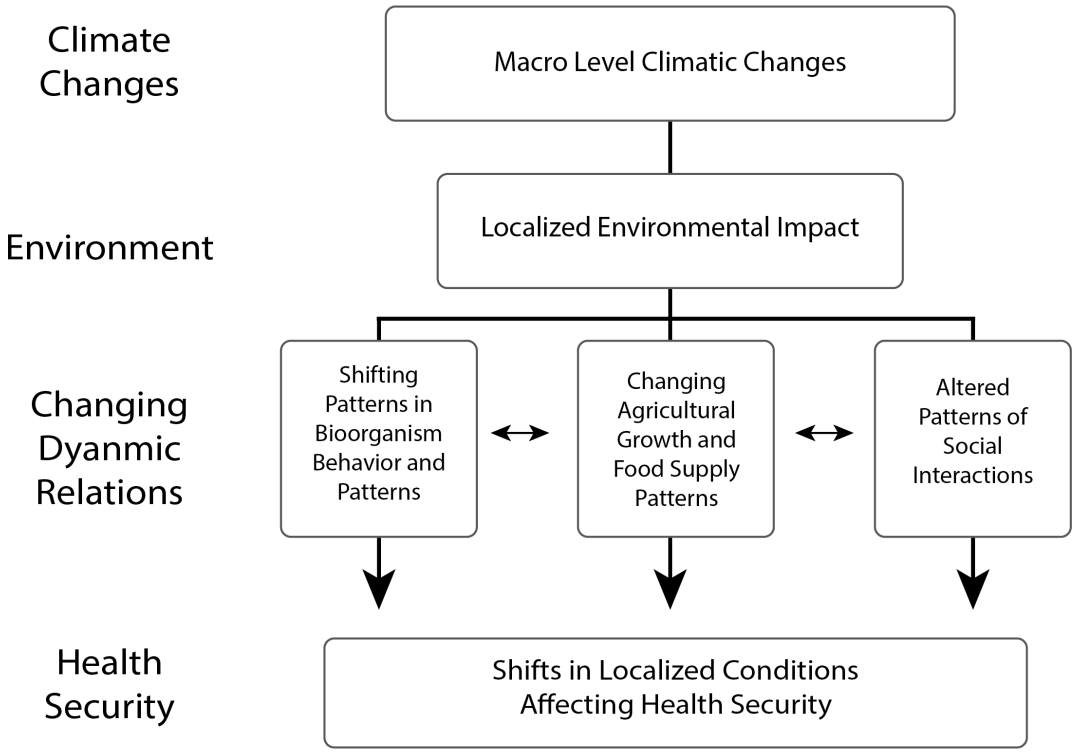
INTRODUCTION[1]

In 2009, *The Lancet* published the first in a series of commission reports on the health impacts of climate change.[2] It was the longest single piece ever published in *The Lancet* at that time, offering a full-throated justification for its principle conclusion: climate change is the biggest global health threat of the 21st century. The subsequent 2015 report reaffirmed these conclusions and presented as robust a picture as possible of the emerging scientific understanding of the linkages between climate and health, as well as affirmative policy steps forward to address them.[3] The linkage between climate and human health outcomes is not tenuous and is potentially as profound as the impact of climate change on ecosystems and overall planetary health. Climate plays a central aspect in the ecological systems on which human systems rely, from hydrological systems that provide the quantity and quality of water populations depend on, to spatial distributions of species and their associated pathogens, and even the predictability of the timing and severity of extreme weather events. However, correctly anticipating the influence of a changing climate on human health outcomes is challenging due to complex interactions between climatic, biotic, and human systems. This research begins with an overview of the nexus between climate change and health and subsequently considers potential ramifications for global security. It concludes with a discussion on policy steps to mitigate the risks to health posed by climate change, including some measures which may even yield overall health improvements, or what are known as *health co-benefits*.

The difficulty in anticipating the health impacts of climate change is because the preponderance of the causal links between the two are indirect and complex, mediated through both the biosphere and human social systems. Direct effects, such as health risks associated with extreme weather events like storms, drought, floods, and heatwaves can be more easily tracked. However, changes in environmental conditions can also lead to changes in productive, social, and biological processes that in turn, impact health. As Figure 1 shows, atmospheric conditions that induce macro-level climate change affect localized environmental factors. This relationship highlights the specific regions and time

periods that are associated with the differential impacts that climate change can have. The regional and localized impacts of climate change can be delimited into three categories that affect health: (1) shifting patterns in microorganism behavior and patterns, (2) changing agricultural growth and food supply patterns, and (3) altered patterns of social interactions. Each of these dynamic relationships has differential impacts on local conditions that can affect health security and are addressed sequentially.

Figure 1: The Indirect Effect of Climate Change on Health Security



MICROORGANISMS AND DISEASE

The difficulty in establishing the link between climate change and patterns of micro-biotic disease, particularly those related to viruses and diseases that affect human health and security, is in the ecological and social complexity that affects the spread of microorganisms. This complexity makes causality difficult to establish between the larger macro-level phenomena of climate change and the more micro-level problems that affect microorganisms, which may also be affected by agriculture, human population density, health infrastructure, and sanitation. Ecological complexity makes it difficult to rule out alternative explanations for any pattern changes that we may observe. This problem is crucial because unidimensional science and policy solutions may be insufficient if they address only factors contributing to climate change (treating the symptoms as opposed to the cause of the syndrome). As such, Kovats *et al*. have argued, there are three conditions

that should be met before in evaluating causal linkages between climate change and fluctuating patterns of disease or processes that affect disease prevalence:

(1) Substantiation of biological sensitivity to climate – this requirement is usually met through scientific investigation in labs or field research;
(2) Weather-related evidence of climate change – significant geographical variations exist in expected changes in climate, making single case or short-term studies limited in their ability to assess the problem;
(3) Evidence of entomological and/or epidemiological impacts associated with climate change –vectors and diseases fluctuations observed in association with meteorological changes must be imbedded within standardized practices for monitoring disease patterns. Changes attributed to climate change should be consistent with the vector's climate sensitivity. [4]

Given these conditions, the link between climate change and altered patterns of disease is deeply concerning and difficult to determine. For our purposes, it makes sense to review the relationship between climate change and microorganisms that affect human health through diseases and vectors that transmit those diseases.

Vector- and rodent-borne diseases are sensitive to changes in climate. Warmer temperatures can also accelerate the reproductive and development cycles of key vectors such as mosquitos and parasites. Temperature tends to result in greater vector density and bite frequency, especially when combined with overall higher levels of precipitation, which increases the likelihood of humans being infected. As the long-stable climate patterns change, regions that were previously inhospitable to certain vector-borne diseases may become breeding grounds. Further, impacts on human health may be non-linear (as a function of total area affected), as newly affected populations may have little or no immunity.[5] At least in the short-term, these relationships are well-established.[6] However, While these principles are understood, climate change also potentially impacts a multiplicity of other environments, such as habitat destruction, land use changes, pesticide use, population movements, and pesticide resistance, amongst other factors, that can also affect vector patterns in less well-understood ways.[7]

Research on pathogenic vectors and climate change has focused on a number of specific pathogens, including mainly mosquito vectors (malaria, dengue fever, yellow fever, Chikungunya fever, West Nile virus, Rift Valley Fever, and Ross River Virus) and tick vectors (encephalitis, lyme borreliosis, tularemia, human granulocytic anaplasmosis, human monocytic ehrlichiosis, and plague).[8] Because of their endemic nature in many developing countries and mosquitos' high sensitivity to temperature change, researchers and policy makers have given significant attention to how climate change may affect malaria.

About 3500 species of mosquitos exist throughout the world, predominantly in tropical and subtropical regions. [9] One of four parasites causes malaria, which is transmitted by the female of about 60 species of anopheles mosquitos. [10] Females consume blood protein needed for feeding eggs. Salivary excretions that help this consumption also provide a pathway to transmit viruses, protozoa, and nematode worms.[11] Malarial transmission occurs during this feeding stage of reproduction.

Recent climate-related research has focused on the potential for climate change to spread malaria to areas where malaria was rare or unknown. As the climate warms, viable

habitat for mosquito populations responsible for malaria (primarily *Plasmodium falciparum* and *Plasmodium vivax*) may expand as higher altitudes and latitudes become accessible.[12] However, historical transmission patterns of malaria show the difficulty in linking its spread solely to climate change.

Malaria has been a problem throughout history. It was common in ancient Greece and Rome, with a wealth of authors making reference to fever areas and attributing the disease to animals too small to be seen.[13] The Dark Ages saw malaria strike the invading Visigoths, Vandals, Ostrogoths and other conquering armies. The Medieval warm period and the great economic growth that accompanied it also saw periods of malarial outbreak. Despite a severe cooling trend in the 15th century, malaria persisted. The Little Ice Age that ensued over the next 200 years still saw persistent malarial infection. Beyond the Little Ice Age, temperatures generally returned to pre-16th century levels normal in Europe. During the 18th and 19th centuries, malaria was still common, but its geographic limits were becoming known. In Britain, malaria moved as far north as Inverness and it was endemic in some parts of Scandinavia. In Russia, it was common through the Baltic areas and along the same latitudinal lines through Siberia.[14] During the second half of the 19th century as industrialization and economic development began to occur in many areas, malaria began to decline. After the 1880s, cases of malaria became rare in England and Germany with similar experiences occurring across a number of European countries.[15] By 1975, malaria had been eradicated from Europe.

This long history indicates two instructive factors about malaria and climate change. First, Long-term climate and short-term weather patterns can affect malarial transmission.[16] Researchers have highlighted this relationship particularly in cases of highland malaria, which has experienced increases in regional occurrences since the 1980s.[17] Because of this trend, speculation on the role that climate change may be playing in the malarial outbreaks has grown. Given the altitudinal range in which highland malaria thrives and because temperatures negatively correlate with altitude, this is potentially a natural laboratory for examining the linkages amongst vectors, vector transmission, and climate change. Indeed, empirical studies have affirmed a relationship between rising temperatures in the highlands of East Africa and rising incidence of malaria.[18] A slew of dynamical models draw upon climate projections and predict dramatic increases in prevalence.[19]

However, as Kovats et. al. argue,[20] there are complicating issues that again compromise the ability to link climate change to the spread of malaria. While seasonal and annual fluctuations in temperatures may have benefits for malaria-carrying mosquitos, such as accelerated larvae development and adult survivability. The dominant factor for malarial transmission is the presence of breeding grounds, which may be severely inhibited by a lack of rainfall.[21] Thus, even if temperatures are increasing, the lack of precipitation —and resulting bodies of water where mosquitos breed —means that there may be limitations of using climate change as an explanatory factor in malarial transmission in highland areas. In some cases, climate change may result in increased temperatures but simultaneously less precipitation, or precipitation that is less frequent but significantly higher volume, which could wash away eggs and larvae, effectively decreasing mosquito populations.

The relationship between altitude and temperature is also affected by other conditions such as latitude and continentality, which exemplifies the degree to which

climate in a region reflects interior areas of a large land mass.[22] The correlation between altitude and rainfall is significant but it is highly variable and weak. Moreover, ascertaining a baseline 'historical norm' for malarial transmission has been subject to expert opinion and systematic survey bias.[23] Finally, it is also the case that vectors do not neatly conform to simple altitudinal cutoff markers that make seasonal and annual variations in malaria patterns easy to predict. Thus, while anecdotal evidence shows that climate change affects vectors and pathogens, as the historical case of malaria demonstrates, the linkages are a complex interaction that involves endogenous social and natural factors as well.

This analysis should not be interpreted as suggesting that climate change does not pose a threat to human health via an increase in the prevalence of vector-borne illnesses. It is very likely that it does. Rather, the takeaway should be that the geographic distribution and severity of health impacts are resistant to precise prediction, complicating efforts to mitigate risk with effective policy action. Moreover, up to this point the analysis has been primarily focused on only a single species, malaria. Climate change stands to impact the spread of many microorganisms, each of which is likely to respond in its own way. For example, dengue fever is sensitive to temperature, but is more prominent in urban areas in developing countries where water resources are often improperly stored. Similarly, qualified studies have also linked warming to schistosomiasis and fascioliasis,[24] leishmaniasis,[25] Lyme disease,[26] hantavirus,[27] tick-borne encephalitis,[28] and others.

CHANGES IN AGRICULTURE AND FOOD PRODUCTION

While infectious disease transmission has been a central concern in climate change and health security discussions, climate change can also affect health indirectly via impacts on agriculture. The United Nations Food and Agriculture Organization (FAO) defines food security as, "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy lifestyle".[29] According to Schmidhuber and Tubiello, the definition comprises four dimensions:

> (a) availability – how available food is, which is determined by the cultural factors and the agricultural, climatic, and socio-economic conditions that affect farming practices
> (b) stability – either food supply or people's wherewithal to buy or trade for food is insufficient to acquire nutrition reliably.
> (c) access – entails having appropriate entitlements to acquire appropriate food. In the developed world, one's *entitlement* to food is almost entire determined by their ability to purchase it with currency or grow it on land they possess rights to. But in the developing world auxiliary social, political, legal and economic arrangements may exist that also determine access.
> (d) utilization – includes food safety and nutrition which affects health security through the inclusion of sanitation issues. [30]

These dimensions demonstrate the complex relationship that food security has with climate change. Most importantly, as Brown and Funk point out, food insecurity is

not just a byproduct of climatic factors, but is strongly affected by prevailing economic, agricultural, and public policies.[31]

The availability of sufficient quantities of nutritious foods, obviously, has a tremendous impact on human health. Chronic acute malnutrition is estimated to be the cause of roughly 3.5 million deaths annually, especially in pregnant or nursing mothers and children.[32] Low birthweight and sub-optimal breastfeeding greatly increase child mortality and stunt growth, diminishing long-term life prospects. According to the FAO, about 793 million people suffered from chronic undernourishment in 2015.[33] Short-term effects of undernourishment include illness, weakness, delayed physical and mental development (in children), behavioral abnormalities (mainly in children), hypertension, reduced capacity for work, psychological trauma, and insulin resistance.[34]

While broad scale evidence for a linkage between climate change and food security exists, the complexity of food systems and their connections to environmental conditions make outcomes difficult to predict at the local level, as was the case with infectious disease. Direct impacts of climate change on food security include reduced agricultural productivity as a result of increased frequency and severity of flooding, sea-level rise, heatwaves, drought, and fire. Though this is not, strictly speaking, a consequence of climate change—but rather shares a common cause—ocean acidification resulting from the increased uptake of CO_2 stands to further deteriorate the productivity of natural fisheries and aquaculture. There is a plethora of secondary effects that are straightforwardly traceable to climate change, but hint of far more complex downstream processes. For example, wildfires can create opportunities for invasive species, pests, and plant pathogens to alternative ecosystems, potentially diminishing biodiversity. This could have a devastating effect on marine fisheries and pollinator populations upon which agriculture depends.[35] Heatwaves are not only harmful to crops directly, but also reduce the ability of human and animal laborers to engage in the physical work of agriculture,[36] lowering overall productivity in this way.

In terms of direct and secondary impacts, numerous empirical studies predict substantial decreases in agricultural productivity over the course of the 21st century. Combining climate projections from the International Panel on Climate Change (IPCC), Battisti and Naylor predict that as much as half of the world's population could face food shortages as harvests of staple crops like corn and maize plummet.[37]

Research on the extended, more complex linkages between climate change and food security has been lacking. Some studies have assessed the impact of climate change as increasing the number of undernourished people by 5-26% in 2080.[38] However, these numbers are predicated on the continuation of existing patterns of economic development, which may not obtain. As such, these studies could be under- or overestimating the number of undernourished people in many locations based upon an assumed level of economic performance. While high-quality, long-term projections of climate change exist, the status of our models for predicting future patterns of economic development is far more rudimentary.

Economic development, while challenging to predict at relevant timescales, critically moderates the impact of climate variables, such as temperature and precipitation, on productivity. In highly-developed countries, technological solutions such as artificial irrigation, genetically-engineered drought- and heat-resistant crops, pesticides, sea walls, and shelters for livestock—as well as more unusual agricultural

technologies and methods such as large-scale hydroponics—could mitigate the effect of climate change on agriculture. Agricultural systems in developing countries, where agriculture is more dependent on rainfall and national irrigation, are much more vulnerable. Moreover, global declines in food production stand to raise food prices, rendering wealthier countries better able to avoid shortages.[39] For less developed and middle-tier countries already suffering from declining yields, food imports may be a salvation few can afford.

Economic modality is perhaps even more important than development status in determining impacts on food security. Productive systems reliant upon smallholder and subsistence farming and fishing, pastoralist communities, and indigenous peoples engaging in hunting and gathering possess limited abilities to adapt technologically or acquire foodstuffs through trade in other kinds of goods.

In what might be described as a cruel twist of fate, Agricultural research predicts increased temperatures may actually increase crop yields in the temperate latitudes, where societies already tend to be richer. At the same time, temperature increase could render the arid and semiarid regions of developing world—particularly in Africa—inhospitable.[40] Adding to this mixture is the direct impact that greenhouse gases have on crop yields. researchers reviewing hundreds of CO_2 enrichment studies have reported a consensus that an increase in atmospheric CO_2 will most likely have "growth-enhancing effects."[41] However, while CO_2 does have a positive benefit for plant growth, it is not generally the growth-limiting factor, with growth outcomes more directly limited by soil nutrient and moisture availability. Again, insofar as CO_2 increase has benefits for agricultural production, wealthier, more developed societies able to leverage advanced irrigation systems and fertilizers stand to enjoy the disproportionate share of them.

While research suggests a mixed, and in some cases, positive impact, on crop yields, these findings must also be placed in the context of the other impacts of rising temperatures, fluctuating precipitation, and rising CO_2 levels – namely the likely increase in crop destroying insects, plant pathogens, and weeds that compete for water, light, soil, nutrients, and land space. As well, weeds can also harbor crop diseases and destructive insects.

Plant pathogens may experience the same type of fluctuations that vector borne diseases in humans may experience. In 1999, Coakley *et al.* report that while studies generally are limited to fungal diseases, under rising CO_2 conditions, fungal infections in plants were initially delayed and more difficult to establish; however, once established, fungal colonies grew much faster under increased CO_2 conditions.[42] As well, changing temperatures may activate dormant pathogens that crops and plants harbor, leading to diseases in warmer climates. While significant progress has been made since, much is still unknown about the impact of climate change on the distribution of plant pathogens. This is primarily due the complexity of biotic and non-biotic interactions impacting crops. The greatest strides, in turn, have been made regionally; as such, wealthier regions with greater budgets for research have benefited the most.[43] Globally, the uncertainty of predictions of change too severe that, as Shaw and Osborne argue, mitigation strategies may only be reactive, not proactive.[44] They argue,

> *What can be said, as has been argued above, is that climate change will bring, above all, surprises. The most important and obvious policy recommendation is that research capacity and knowledge bases need to be*

> *at least maintained, so that when a surprise happens, people who can rapidly understand it and respond are available. It is hard to see how this can be done without maintaining a diverse scientific base, including, for example, specialists in the ecology or taxonomy of specific groups, and in field epidemiology, as well as molecular pathology.* [45]

Unfortunately, much of the world is unlikely to possess these capabilities or the means to implement expensive, reactive solutions. As a result, much of the world's food supply remains threatened.

The impact of climate change on food security also extends to aquaculture and global fish production. The captured production of fish and other ocean fare has been declining since 1989, and aquaculture has become an important outlet in fish supplies and communities that rely on those supplies for their own food security. According to Brander, climate change will have direct and indirect effects on the commercialization of fish stocks. Increasing temperatures already are producing shifts in fish migration and locations. [46] Where some fish stocks may migrate and increase, other areas may experience local species extinctions. [47] When some species migrate, novel species may move into an area and compete with native species. Coral destruction through bleaching may further reduce species diversity and contribute to reduced fishing capacities locally. [48] Inland fish production is also threatened with the potential disappearance of lakes and rivers (Lake Chad's demise being one of the most dramatic examples of this).

The impact of climate change on food security is again a puzzle with many moving and shifting pieces. Research shows that people in some areas may benefit from the effects of climate change on agriculture, while people in other areas will suffer greater food insecurity. In areas where food security becomes unstable, disease-related malnutrition may increase. Such effects might include impaired physical growth, increased respiratory infections, malabsorption, and impaired organ and immune functions, making people more susceptible to other diseases.

ALTERED PATTERNS OF SOCIAL INTERACTION, ECONOMY, AND SOCIAL STRUCTURES

As a result of the potential impact on short-term weather conditions, the long-term ecological conditions and the concurrent impacts on pathogens, vectors, and food security, researchers have postulated that climate change may have implications for social interactions, broadly construed to include both states and their populations. changes to social interaction patterns may lead to changes in health security.

While social scientists have long debated the role of the state in the global political system, it remains a central element of the system, strongly tied to the populations over which they govern. Historically, as states have expanded in power and wealth, the global system, through complex political, economic and social interactions amongst states, also began to divide on those lines of power and wealth. Today, the global system has two key features that will produce differential impacts on states within the climate change debate. The first is the long-standing principle of sovereignty and the second is the global inequality that has emerged within the system over its long history.

State sovereignty is a central component to issues of security for states, with states focused on protecting or compensating for weaknesses that make them vulnerable or

heighten their perceptions of threats to their sovereignty and security. The problems caused by climate change present unique challenges for the state because they often transcend state borders. For example, declining crop yields, increases in vector-borne illnesses, or an increase in the power and frequency of extreme weather events may occur regionally. In addition, problems that do not transcend borders may still be challenging because states may be reluctant to deal with the problem or to cooperate with other states if the problems to not directly affect them. Moreover, the geography of climate change and the associated costs of its large-scale impacts mean that climate change will be a differential problem for the global state system. Climate change for most developed, wealthy states may be a matter of adaptation; for poorer, developing states particularly in the global south and in low-lying coastal areas, there are few feasible adaptation options to moderate temperature increase scenarios. These states also possess the most vulnerable populations and low state capacity and already confront significant challenges to human security.

As Buzan has pointed out, climate change has the potential to alter the very geography of human habitation, leading to fundamental shifts in the social and political interactions within the global system.[49] As early as 1971, after the release of President Johnson's Science Advisory Committee report on atmospheric CO_2, Falk recognized the problem of climate change through what he termed 'the first law of ecological politics'; specifically, "there exists an inverse relationship between the interval of time available for adaptive change and the likelihood and intensity of violent conflict, trauma and coercion accompanying the process of adaptation."[50] Falk's proposition focuses on two issues: the rapidity of change and reaction time to that change, and the probability of social interaction becoming more intense and violent. In this vein, researchers have focused on two areas of social interaction that may evolve from climate change with direct implications for health security – violent conflict and mass migration.

Researchers focusing on the impact of climate change on violent conflict draw upon issues of state survival that are linked to growing resource scarcity and competition to sustain population livelihoods.[51] Through changes in desertification, sea levels, spreading disease vectors, and natural disasters, resources will become scarcer leading states to compete directly with each other. Moreover, disruptions to economic systems and patterns of sustainability will lead to mass migration out of areas, subsequently placing people in greater violent competition for scarcer resources.[52] The implications of such connections are significant. Some research has even attributed genocides (i.e. Rwanda and Darfur) to ecological changes and ecologically induced migrations. The connections to health security are derived from the long line of research that links conflict and migration to increased violent deaths, potential for disease outbreaks (particularly in refugee camps), conflict induced food scarcity, and sanitation issues.[53]

The general problem in this body of literature is the same problem confronting our understanding of climate change and its relationship to the biosphere. The inherent complexity of the systems involved presents the same problem of causality that shadows the link between climate change and human behavior such as violent conflict or mass migration. Migration tends to be mostly intrastate and not interstate. In cases of reported environmentally induced migration, often times other factors contributed to the ensuing violence.[54] Reuveny shows this multiple factor issue in research on migration and violent conflict.[55] In examining 38 cases of climate-induced migrations, 19 of the 38 were not coextensive with significant levels of violence. Of the 19 that did not have a violent

component, eight involved intrastate (civil) wars, three involved interstate conflicts, and eight involved inter-communal conflicts.[56] At best, it would appear that environmental degradation linked to climate change does not always lead to conflict. When it does, it is usually a stressor factor that adds to preexisting conditions that may make violent conflict more likely and more intense.[57]

HEALTH AND SECURITY NEXUS

Within the health security discourse, *health security* may be considered in two interpretations: First is the notion of 'health security' that refers to securing health itself, which is discussed above. The second interpretation, which we might prefer to think of us as "health and security", considers the contributions of health to global security.[58] In this section, we will discuss the latter.

The 1990s saw a proliferation of public and scholarly research seeking to recast global health issues as a critical aspect of national and international security.[59] In 2002, the unanimous passage of Resolution 1308 in the United Nations Security Council officially declared HIV/AIDS to be a threat to global security. The Resolution stated that the spread of HIV/AIDS was both a result and cause of socioeconomic and political conditions leading to violence and instability, and that a globally coordinated response was necessary to address it. Subsequently in 2002, the Bush Administration published its first revision of *The National Security Strategy of the United States*, establishing global health as a national strategic goal and lead to an unprecedented $15B plan to combat HIV/AIDS globally.[60]

The literature and these policies, however, were largely concerned with the security implications of endemic disease and the potential for regional and global outbreaks of highly infectious disease. In important regards, the health impacts of climate change may follow a dynamically different logic, as they are less about what *is* endemic, but what is *becoming* endemic; climate change mediated health impacts are less concerned with outbreaks and more concerned with slower processes deteriorating public health outcomes in response to a greater variety of forces, including but not limited to, chronic and acute malnutrition, changes in the distribution zoonotic diseases, and decreased economic productivity. We will consider several potential health-related linkages through which climate change may have implications for global security.

Susan Peterson argues that while infectious disease has security implications, it is unlikely to cause violent conflict on its own.[61] This is likely also true for climate change mediated health outcomes. Peterson lays out three paths through which infectious disease can provoke war, which may be adapted to the present question.

1. **Generating disputes over climate change adaptation policy**
   Mitigating the effects of and adapting to climate change is an inherently international effort. In many cases, states may find themselves facing a collective action problem, such that they are each mutually relying upon their neighbors to take specific actions to minimize shared risk, and to do so in a way that does not threaten the core interests of their neighbors. Such efforts may include costly investments in health infrastructure, land management, water resource management, and sewage treatment. These investments may directly inhibit vector-borne

illnesses from gaining a foothold in a region and help preserve local socioeconomic conditions and prevent transnational health crises. The regional politics of climate change mitigation and adaption could be acutely contentious in such cases where multiple countries share common resources, especially fresh water. This may be called *hydro politics*. As precipitation patterns change, so will the spatial distribution of water resources. At present, the literature in International Relations and Conflict studies has produced a mixed assessment of water as a source of conflict. Stetter argues that this is so because while no major conflict has ever been classified as unambiguously about water, water-related issues are often "present in innumerable conflicts, but their role … rhetorically belittled when compared to allegedly more central factors such as traditional notions of security, territorial claims or identity discourses." [62] Accordingly, building effective transboundary water management regimes that minimize conflict over shifting—and in some cases dwindling—resources will be critical.

2. Accelerant and/or perpetuator of instability

A second health-mediated path linking climate and security outcomes is the potential for climate change to be an accelerant, or perpetuator of instability. In 2004, former United Nations Secretary General Kofi Annan asserted that global development was an "indispensable foundation" of collective security; "[E]xtreme poverty and infectious disease", he argued, "create environments which make more likely the emergence of other threats, including civil development."[63] Promoting global development featured prominently in the national security strategies of the Bush and Obama Administrations. In the Bush Administration's *National Security Strategy of the United States,* the Administration argued "[d]evelopment reinforces diplomacy and defense, reducing long-term threats to our national security by helping to build stable, prosperous, and peaceful societies," – a sentiment which remained through several revisions of the Obama Administration.[64]

At the same time, the health impacts of climate change, such as the proliferation of infectious diseases and agricultural disruption, stand to undermine the development goals meant to increase the capacity of the poorest societies to deal with them. Deteriorating public health can be expected to result in fewer people working. Some individuals may have to leave the workforce because they become ill or to care for sick family members. When a parent or provider is unable to work, children may be forced to engage in labor rather than attending school, resulting in long-term impacts on life prospects. Lower productivity, combined with increased frequency of extreme weather events, renders existing infrastructure such as roads, reservoirs, dams, dykes, and floodways under increased pressure, while simultaneously reducing capacity for maintenance and investment in new mitigation projects.

In many parts of the world, climate change is occurring over a backdrop of population growth and movement. In particular, decreasing returns to agriculture from heat- and flood-damaged crops is likely to push many rural inhabitants into increasingly congested cities, straining infrastructure, presenting further public health challenges both for the migrants and for denizens. Developing economies unable to absorb immigrants into urban labor forces will face high rates of

unemployment with weak and overstrained, or non-existent, safety nets. Urban slums will be not only breeding grounds for disease, but crime and other social ills, likely to be blamed on immigrants or already marginalized sub-populations. Weak political institutions may be unable to accommodate these complex new social and economic challenges, raising the risk of political instability and civil conflict. Conflict ultimately undermines populations' capacities to adapt to climate change further.

Both rapid-onset environmental crises and longer-festering political crises have potential to spill across borders, where neighbors may be wrestling with similar challenges and similarly strained resources, legal structures, and institutional capacities to deal with migrants. Regionally, we could see a *refugee syndrome* marked by cascades of displacement, instability, and more refugees, inevitably moving *northward* into relatively better off countries of the global north. This is not new. A steady flow of migrants into North America and Europe has fueled the rise of right-wing, nativist movements seeking the reaffirmation and hardening of borders. The perceived need to take swift and determined action to stem the flow of migrants by either physical blockade or deterrence is often incompatible with tenets of Western-liberal democracy. Accompanying the resurgence of illiberal parties and political dynamics in the United States and throughout Europe has been a troubling pattern of *democratic backsliding*. Democratic Peace theory would suggest that even if a certain amount of transatlantic cooperation between right-wing movements is observed, the long-term trajectory of the dissolution of a liberal, democratic world order is on a path to renewed hostilities in places where interstate war was believed to be obsolete.

3. Shifting balance of power

Peterson raises the potential of a third path through which climate-induced deterioration of health outcomes could have implications for regional or global security. In the realist tradition of international relations theory[65], security regimes reflect essentially stable configurations of national power. Exogenously or endogenously caused shifts in relative power, or capabilities, between states can therefore precipitate a period of heightened uncertainty in a system of states. National leaders may perceive moments of opportunity to extend their national interests at a suddenly weaker adversary's expense, or alternatively, feel they may soon find themselves at the end of someone else's spear. Either way, f*ortuna iuvat*, fortune may appear to favor the bold leader who preempts the other.

This line of reasoning may seem outmoded, a paranoia born of 20th century preoccupation with 19th century conflicts, but there is a material basis for concern. Heterogeneously-distributed impacts of climate change such as damage to critical ports, infrastructure, coastlines, lines of communication, political instability, or health impacts could alter both short- and long-term development trajectories of states, distributions of latent power such as the size and health of states' populations able to engage in military service, gross domestic products, and technological bases. Moreover, while the chance of an acute catastrophe such as a single (or series) of extreme weather events or an epidemic precipitating such a large-scale structural rebalancing seems unlikely, the temporal and geographic horizons of

> climate change are long. The chances of such an event unfolding in a given time or place is low, but the world is large, and events may unfold slowly over the course of decades, where single-digit differentials in economic growth rates can have many times-compounded impacts on relative capabilities.

These three paths for health-mediated impacts of climate change on global security are all potentially compounded by an additional factor. As the most-vulnerable populations persisting on the encroaching frontier of climate change convulse, the ability of the international community to deploy peacekeeping—or peacemaking—forces to affected regions may also be significantly diminished. Extreme heat, endemic disease, complex and sensitive relationships with desperate denizens, and other environmental hazards that stand to worsen with climate change, can greatly increase the cost of international interventions in areas at risk of or in the throes of violent conflict. In addition to the financial costs of deploying or basing forces to affected regions, harsh conditions where heat, disease, and high-risk interactions with local people may leave deployed personnel trapped within the walled perimeters of secured compounds. This would greatly increase the burden of deployment on individuals, with implications for moral and force exhaustion. Under such conditions, members of the international community can expect difficulty finding and maintaining the political will to sustain prolonged operations.

POLICY RESPONSES

Climate change policy has generally focused on two fundamental categories of activities: mitigation and adaptation. Mitigation activities are those directed at reducing the level of greenhouse gases in the atmosphere, whereas adaptation policies focus on how to respond to changing conditions and maintain the various ecological and human systems expected to be impacted by climate change.[66] The impacts of climate change to health security are most closely associated with adaptation policy and will involve managing existing health security risks that may be compounded by climate change impacts as well as new health risks that may emerge. Existing health security risks, such as malnutrition or limited access to health care, will likely increase with extreme weather events such as drought, floods, and heat waves. New health risks may include increased exposure to new zoonotic diseases as habitats and species adjust to new climate conditions and as the range of existing disease vectors increases.[67] While the complexity of interactions across climatic, natural and social systems make it difficult to anticipate the potential increased health risks, or where, most of the sources of these new risks are already managed within current health policies. The challenge is likely to be greatest in those regions where even well-understood health risks go unmanaged, as is often the case in the global south.

The health security impact of climate change will be determined not by the natural systems that generate exposure to risk, but rather by the ability of social and political systems to respond rapidly enough to minimize current climate related health impacts as well as react to new risks. While significant work has been done examining the social vulnerability of populations to climate changes,[68] perhaps a better conceptualization of the problem is to examine the vulnerability of the various political and policy systems to be able to respond adequately. Such an approach would re-emphasize some of what has been written in the vulnerability literature already, for example, poverty as a key limitation of an individual's ability to cope with health threats and the pivotal role of poor

governance in not reducing risk at the national and regional levels.[69] However, it would also highlight aspects of health security and climate that are often overlooked. The emphasis on the level of economic development at a national level as a rough proxy measure for capacity to deal with climate change impacts often overlooks policy sub-systems even in wealthy nations that may be too inflexible to respond to new risk or ineffectual when they do respond. The response by the national government to Hurricane Katrina in the United States remains a lingering reminder that the potential capacity to respond does not equal the effectiveness of the response.[70] Likewise, the large number of deaths associated with the 2003 heat wave in France was due not to the event itself, but due to a large number of medical staff being on vacations during the period and inadequate monitoring of high -risk populations.[71] Particularly in the developed world, healthcare access by low-income populations may be a more significant driver of the level of risk than climate induced changes to the environment. However, in the developing world, climate change stands to undermine the development necessary to achieve and maintain adequate health systems.

A focus on the social systems that produce risk-reducing strategies and improve the resilience of local communities and regions will also likely help illuminate the factors in many low capacity states that can help minimize the impacts of climate change on health security. Local social capital and the ability to pool resources when needed, offer existing social structures on which to build improved local capacity to adapt to new climate conditions or respond to extreme weather events.[72] Since there are few altogether new threats to health outcomes that climate change poses, effective policy responses will entail better diffusion of existing practices that have worked and adapting lessons from elsewhere to a local context, rather than a need for radically new approaches. The policy tools to deal with most of the climate-induced health security threats already exist, however they will require faster deployment to new areas that stand to become increasingly difficult to reach. This does assume mitigation policy that begins the reduction of greenhouse gas emissions and that the worst-case scenarios of climate change do not come into effect. There are limits to the speed at which any system can adapt, and the worse climate scenarios would exceed the capacity of most local, community and national policy systems.

An additional dimension of climate change mitigation policy, from a global health policy perspective, is that many of the measures that must be taken in order to reduce CO_2 emissions also produce what The Lancet Commission calls "health co-benefits of emissions reduction," which are experienced globally.[73] Reductions in the emissions of spent fossil fuels reduce air pollution and improve respiratory health. The mastery of renewable energy technologies, particularly solar and wind, will lower the cost of adoption in the world's poorest countries. In 2015, the World Health Organization found that in 11 sub-Saharan African countries, only about a third of healthcare facilities had reliable electric power, with about a quarter having none. Electrification, in this case, stands to readily produce health benefits in the developing world while rendering the global health system more robust overall. Clean electrification further stands improve health by reducing the need for burning fossil fuels for in-door uses such as cooking, reducing exposure to high concentrations of combustion byproducts. Cheap, clean, and reliable power also makes it possible for homes to be designed with insulation and climate control

in mind, protecting vulnerable people from extreme weather events, exposure to temperature extremes, as well as vector-borne diseases.

CONCLUSIONS

The global health implications of climate change, as well as their potential downstream implications for global security, are inherently difficult to predict with a high degree of accuracy. At the same time, we know that strengthening the capacity of communities to adapt climate change and respond to health crises protects against the spectrum of climate-related health threats. Further, even if we do not know the *where* the *when* of climate-induced health crises, the wide-scale investment in social capital, clean energy, and ecosystem protection produces a large number of health benefits on their own.

Time, however, is of the essence. From a global health and development policy perspective we are in a race against time because climate change, absent effective adaption policy, stands to deteriorate capacity, potentially resulting in downward spirals of misery. Accordingly, the policy road going forward is relatively clear: Climate change mitigation and adaption should be central to global development policy. Contrary to the positions of noted climate iconoclasts like Bjorn Lomborg, climate change mitigation and global development are not separate issues. Rather, both are essential components of an agenda to alleviate global health and economic inequality.

Adapting to climate change is more than a humanitarian issue, but also has implications for global security. A changing climate raises the specter of state-level disputes over mitigation and adaptation policy, could be an accelerant of domestic and regional instability, and in the long-term result in fluctuating balances of power—all threatening to stall or roll back any progress made in global health outcomes. Further, the ability of international actors to deploy to troubled regions could be complicated, or even deterred, by climate change. Regional and global security institutions must remain actively engaged, emphasizing cooperative crisis management, climate change mitigation and adaptation, and robust economic connectivity.

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ELEVATING THE STATUS OF HEALTH IN GLOBAL ENVIRONMENTAL POLITICS:
SECURITIZING THE NEXUS BETWEEN HEALTH AND CLIMATE CHANGE

Geoffrey B. Cockerham

Considerations of health have received little notice in international climate change negotiations and agreements. To address this issue, the nexus between climate change and health in global politics should be strengthened. I argue that this can be accomplished by: (1) adopting a strategy based on the securitization of the relationship between health and climate change by using a human security framework and (2) that prospective norm entrepreneurs must take advantage of the fact that climate change is part of a regime complex, rather than a comprehensive regime, and use their tools of soft power to persuasively advance stronger measures.

INTRODUCTION

A decade ago, a Lancet Commission on Health and Climate Change referred to climate change as "the biggest global health threat of the 21st century."[1] Six years later, another Lancet Commission added that addressing climate change could also be "the greatest global health opportunity of the 21st century."[2] Despite these compelling claims from experts, health has received little attention from policymakers in international climate change negotiations and agreements, resulting in little impact. Why is this the case? It is primarily due to a lack of acceptance in connecting the concept of health to climate change in global environmental politics. To address this situation, the political nexus between climate change and health should be strengthened. I argue that accomplishing this objective will be based on two processes. First, climate change should be persuasively framed as a human security issue by highlighting it as a genuine danger to human health. Second, prospective norm entrepreneurs such as the World Health Organization, health-oriented non-governmental organizations, and medical or scientific epistemic communities must take advantage of the fact that the issue of climate change is not part of a comprehensive regime, which is a set of "implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge."[3] Rather, it is part of a much looser association of various institutions know as a regime complex, which may provide more flexibility and a greater opportunity for these actors to use their tools of soft power to promote change.

A major issue for global health and climate change is that since the early 1990s, climate change has often been shaped in the context of sustainable development. While health can be reconciled with sustainable development, its influence in this area is challenged by sustainable development's stronger association with economic development. Health and economic development are certainly not incompatible. In fact, the good health of a state's population can improve its economic development and, vice versa, a growing economy can provide more resources for a state to utilize in improving the health of its citizens. The problem, however, is that certain economic activities pursued in the process of economic development may also prove to have detrimental

effects on health.[4] This issue demonstrates the complexity of the relationship between health and sustainable development.

A way for health to distinguish itself as a norm within climate change politics is through securitization. Since the 1990s, considerable attention has developed in both academic and policy circles around the relationship between health and security.[5] This rise in recognition of the link between health and security coincides with the United Nations Development Programme (UNDP)'s report in 1994 providing a statement on human security as security based on threats to people's daily lives rather than "security of territory from external aggression, or as a protection of national interests in foreign policy or as global security from the threat of nuclear holocaust."[6] Climate change also has been increasingly acknowledged as a security issue since the UNDP's statement. Effective framing of climate change as a threat to health security, in a comparable manner as infectious diseases, may be a promising means to elevate the status of health in this area by creating a sense of urgency to act sooner and more decisively in addressing climate change rather than the "long game" approach that coincides with sustainable development objectives.

To address this issue, the first task is to discuss the process of using social framing as a persuasive device. In particular, how can a concept such as global health successfully contest countervailing norms in climate change politics and become a primary means to frame the issue for social interactions? The second task is to identify and discuss the international norms of climate change, especially in relation to the principle of sustainable development. Finally, this paper will assess the prospects and potential utility for a norm of global health security to emerge within the international regime complex for climate change and influence global responses to this pressing problem.

IDENTITIES, NORMS, AND THE ISSUE OF NORM CONTESTATION

Social constructivism is an approach that has assumptions about the social process that underlies international relations. One assumption is that the structure for interactions is based on social context as well as material incentives. Another is that actors acquire and define their interests from this structure.[7] As a consequence, the interests of these actors are endogenous. While social constructivism does not reject the idea that states will be prone to utility maximization, it suggests that meaning of utility for states will be subject to the social structure that shapes the interaction.

Due to the endogenous nature of their formation, interests are a significant variable for constructivists.[8] In determining interests of a state, two factors stand out. One factor is the identity of the state. The other factor in determining the interest of the state is the norm. This concept of a norm is used "to describe collective expectations for the proper behavior of actors with a given identity."[9] Powerful norms may even become internalized by the state and develop into part of its identity. If a norm is not sufficiently strong enough to become internalized, it may still constrain the state's decisions and actions. So, how do these norms become part of a state's identity, or at least part of the social structure of an interaction that will shape the interests of the state? In analyzing the process for ideas to emerge as norms, Finnemore and Sikkink have advanced the concept of norm entrepreneurs, which are agents that advocate for new ideas in a particular social context to change the preferences of actors to correspond with these ideas.[10] When a sufficient number of actors accept this idea as an appropriate way to

behave, then the idea emerges into a norm. In assessing the potential of global health to arise to this standard of appropriateness in climate change, this possibility is a viable option.

Framing as a Persuasive Device

Within the social context of the international climate change politics, global health must at least find a significant niche with other norms, both complementary (sustainable development) and competing (neoliberalism). For global health to reach this status, it must be successfully framed. Barnett describes frames as devices "to help fix meanings, organize experience, alert others that their interests and possibly their identities are at stake, and propose solutions to ongoing problems."[11] For global health to emerge as a norm in international climate change, norm entrepreneurs must use appropriate framing to persuade other actors that climate change and health are inextricably linked. If this idea is accepted by a sufficient number of actors, then states will more likely associate climate change as a threat to human health and well-being, which may lead to a more robust policy response to this issue both internationally and domestically.

Research on norm dynamics outlines a process that such a prospective norm would follow to reach such a point where it becomes part of a state's interests. Finnemore and Sikkink describe norms as evolving through a three-stage life cycle.[12] In this first stage, a norm begins to emerge as norm entrepreneurs persuade states to adopt the norm as an accepted standard of appropriate behavior. At this point in the process, framing the norm is of critical importance. These new norms do not enter into a vacuum. They must be successfully framed to compete with other norms and become accepted as the standard of appropriateness. In addition to norm entrepreneurs, organizational platforms are also an important factor in the stage of norm emergence. A prospective norm's emergence may be enhanced if it is supported by international organizations, such as the World Health Organization (WHO) and World Bank, that are persuasive actors due to their expert authority and availability of information.

The next stage in the life cycle is the norm cascade. While Finnemore and Sikkink are not precise at designating the number of states necessary to accept the norm for it to have emerged, they suggest that it must be at least over a third of the states in the international system.[13] In the cascade stage, the chief mechanism in the process is socialization rather than persuasion. In this stage, some form of social rewards and punishments are offered to states to comply with the norm. Once the norm becomes widely accepted, it reaches the third stage of internalization. At this point, the norm has become part of the identity of the state.

This approach provides a useful guide as to how a prospective norm such as global health could emerge within climate change politics, however, it is not entirely clear about the issue of norm contestation. This issue is particularly relevant in the norm emergence stage. In evaluating norms, Wiener's analysis addresses this issue based on the logic of arguing.[14] This logic refers to the role of communicative action in the process of norm contestation. Once a norm has been accepted as appropriate, it will be contested among a hierarchy of norms. Communicative action includes dialogue and negotiation regarding its validity. Those norms that are more persuasively argued and develop into a shared

understanding during this process are more likely to be validated and appear near or at the top of the hierarchy.

Arguing is also a critical factor for Sandholtz's view of the dynamics of norm change.[15] He claims that norms are in a constant state of development, and normative structures are always in dispute. In this sense, even with a rule or accepted norm, actors disagree on how the rule should be interpreted or how it should apply to a particular situation. Due to the lack of an authoritative arbiter in international relations, argumentation and persuasion drive the resolution of this conflict. Sandholtz claims that the effectiveness of persuasion depends on whether it supported by powerful states, fits with existing and accepted norms, and is more consistent with recent practices compared to alternative arguments. Based on this framework, global health must satisfy these criteria for persuasiveness to become a more influential norm within the context of climate change.[16]

As suggested by these criteria, norm entrepreneurs may face an uphill battle if they have difficulty in gaining support of powerful states. In addition, Bloomfield points out further obstacles for such entrepreneurs in the process of norm emergence.[17] One challenge is the role of norm antipreneurs, who are the actors that oppose a prospective norm. Bloomfield, in fact, claims that antipreneurs even have an advantage over entrepreneurs.[18] One strategic advantage is that the antipreneurs could just defend the status quo in the communicative process and place the burden on the entrepreneurs to establish a convincing rationale for why the status quo is faulty or immoral. If that strategy fails, antipreneurs could also contest the prospective norm by counterframing and undermining the norm. Counterframing may also be a strategically favorable strategy when it is centered on maintenance of the status quo. Even if entrepreneurs are able to successfully persuade a consensus of actors that the status quo is inappropriate, antipreneurs can still counter and dismiss the prospective norm as "too radical" or at least "unproven" to foster some resistance among policymakers.

Constructivist research suggests that for global health to emerge as a viable norm, effective framing and argument will be critical factors for a favorable outcome. Norm entrepreneurs must first successfully frame climate change as a significant global health problem. Major actors must then be persuaded that the detrimental effects of climate change on human health either outweigh economic costs, or that these negative health effects are also contributing to a negative impact on economic development. Regardless of which specific frame to adopt, successful framing will be a necessary condition for this global health norm to overcome challenges of the status quo, counterframing, or other competing norms.

THE INTERNATIONAL NORMS OF CLIMATE CHANGE

Climate change began to emerge on the international agenda around the same time as sustainable development. It, along with other environmental issues in the 1980s, contributed to a resurgence of interest in the environment and led to another major conference in 1992 with the UN Conference on the Environment and Development (also known as the Rio Conference) in Rio de Janeiro, Brazil. This conference produced the agreement on the United Nations Framework Convention on Climate Change (UNFCCC). While this agreement was designed to establish a central institution for climate change, the rules and norms for managing climate change have emerged into a structure of a

regime complex instead of a comprehensive regulatory regime. This arrangement means that it is based on a "non-hierarchical but loosely coupled systems of institutions."[19] The regime complex for climate change includes a number of institutional elements such as expert assessments (i.e., the Intergovernmental Panel on Climate Change), clubs (such as the G7, G20 etc.), bilateral initiatives by national governments, adaptation initiatives led by UN agencies, and the international trade regime.[20] Within this complex, however, the most institutionalized component is the UN legal system spearheaded by the UNFCCC.

United Nations Framework Convention on Climate Change

Sustainable development provided a framing device for the UNFCCC. Article 3 (1) of the treaty stated that parties to the agreement "should protect the climate system for the benefit of present and future generations of humankind," and Article 3 (4) specifically mentions sustainable development as a policy that should be promoted by the parties.[21] To complement sustainable development, the UNFCCC also includes a principle of "common but differentiated responsibility." This principle addressed the tension regarding burden sharing between developed and developing states. Particularly, the issue that while all states needed to confront climate change, developed states had greater resources and capabilities to address the problem. Article 3 (5) adds another principle of the need to support and maintain an open economic system as part of the effort to promote economic growth, which would assist states to more effectively address climate change.[22] Collectively, these principles demonstrate a significant emphasis by national governments to try to balance a global response to the problem of climate change with the interests of states, particularly developing states, to continue to promote policies for economic growth.

The UNFCCC also included some important procedural mechanisms to pursue its objective of stabilizing greenhouse gas (GHG) emissions. A Conference of Parties (COP) was established as the UNFCCC's supreme decision-making body. The COP effectively made the UNFCCC into a living document with its periodic review of the agreement as well as its authority to adopt related legal instruments. The UNFCCC also included a financial mechanism to allow for the transfer of financial resources, as well as technology, to assist states in implementing the agreement.

Kyoto Protocol

The Kyoto Protocol, adopted in 1997, was the first international agreement connected to the UNFCCC. The purpose of Kyoto was to go beyond the principles in the UNFCCC and establish more precise commitments of member states to reduce GHG emissions. In particular developed states, which were states specifically designated as Annex I countries (or known as Annex B countries in the Kyoto Protocol), were to accept quantifiable emission limits so that the overall reduction of GHG would be 5% of 1990 levels by 2008-2012.[23] Sustainable development and the principle of common but differentiated responsibility also framed this agreement. The Kyoto Protocol mentions "sustainable development" as an objective for the parties in three separate articles. In terms of common but differentiated responsibility, developing states (or non-Annex I countries) did not have the same quantified GHG limits as the developed states.

This agreement also furthered the UNFCCC with some procedural innovations of its own. One innovation was a joint implementation mechanism in which developed states could earn an emission reduction credit towards its Kyoto target from an emission reduction project in their state or another developed state. Another innovation was a clean development mechanism (CDM) to give credits to developed states for reduction projects in developing states. The Kyoto Protocol also allowed for emissions trading in which a developed state could trade any unused emission units to other developed states. While this agreement created "hard law" commitments for some states by the quantified restrictions of GHG emissions, these procedural innovations provided flexibility in recognition that climate change was a collective action problem.

Despite demonstrating continued support to the objectives of the Rio conference and the UNFCCC, the Kyoto Protocol has generally been viewed with mixed results. The Kyoto Protocol can be considered to be a universal agreement with 191 national governments and the European Union as parties. Politically, however, a significant problem was that the United States, the largest emitter of carbon dioxide among developed states, choose not to ratify the agreement. Canada, which was party to the Kyoto Protocol decided to withdrawal in 2011, while Japan and Russia refused to extend their commitments beyond the first commitment phase ending in 2012. It could certainly also be viewed as problematic that two of the world's largest emitters, China and India, were not bound to specific emissions standards under the agreement.

The Path to Paris

The decade after the Kyoto Protocol was a period that has been referred to as "global warming gridlock" in international climate change politics.[24] The Copenhagen Accord, a short, non-binding agreement was produced at the COP 15 meeting in 2009. Although this agreement continued the principle of common but differentiated responsibilities, it did include a pledge from developing states to reduce their emissions and report their mitigation actions. This point was a significant modification in climate change politics as it was the first time that developing states such as Brazil, China, and India were willing to subject their climate change policies to international scrutiny.[25] In 2011 at COP 17 in Durban, South Africa, parties agreed to a non-binding Durban Platform for Enhanced Action, which called for a second commitment period for the soon to be expired Kyoto Protocol, and even more significantly, it also asked for a new legally-binding instrument for climate change to be approved by 2015. The following year in Doha, Qatar, parties formally agreed to extend the Kyoto Protocol and add a second commitment period from 2013 to 2020.

Despite the political gridlock, the Copenhagen Accord initiated a new approach to the issue in the international climate change regime complex. Bodansky refers to this process as a "bottom up" approach in which states could choose their own target levels and then share their information with others through the UNFCCC Secretariat.[26] This approach permeated the thinking of the parties at COP 21 meeting in Paris, which took place at the end of the 2015 deadline for creating a new legally-binding instrument for climate change. The conference produced the Paris Agreement, which was a hybrid in that it was a legally binding agreement, but its emissions reduction targets were based on a non-binding, nationally determined standards in contrast to the specific binding targets that were included in the "top-down" oriented Kyoto Protocol. In addition to adopting

this "bottom up" approach to climate change, the Paris Agreement also institutionalized the adjustment of the principle of common but differentiated responsibilities from Copenhagen by emphasizing the "common" component over "differentiation" and obligating all states to mitigate and report their GHG emissions.

Other significant legal aspects of the Paris Agreement include its objective to hold the increase in global average temperature to below 2°C of pre-industrial levels with the aspiration of keeping the increase to 1.5°C, the continuation of market-based mechanisms such as emissions trading, a new mechanism to allow for offsets in emission reduction activities for the states' nationally determined contributions, and an enhanced transparency framework that would apply to all states, although with some flexibility for developing countries.[27] Sustainable development remained a well-established principle in the Paris Agreement as it was specifically referenced as a context for a global response to climate change (Article 2 and Article 4), as a goal for the market mechanisms (Article 6), as part of adaptation (Article 7), as part of reducing risk of loss and damage (Article 8), and as a goal for technological innovation (Article 10).[28]

Identifying Climate Change Norms in International Politics

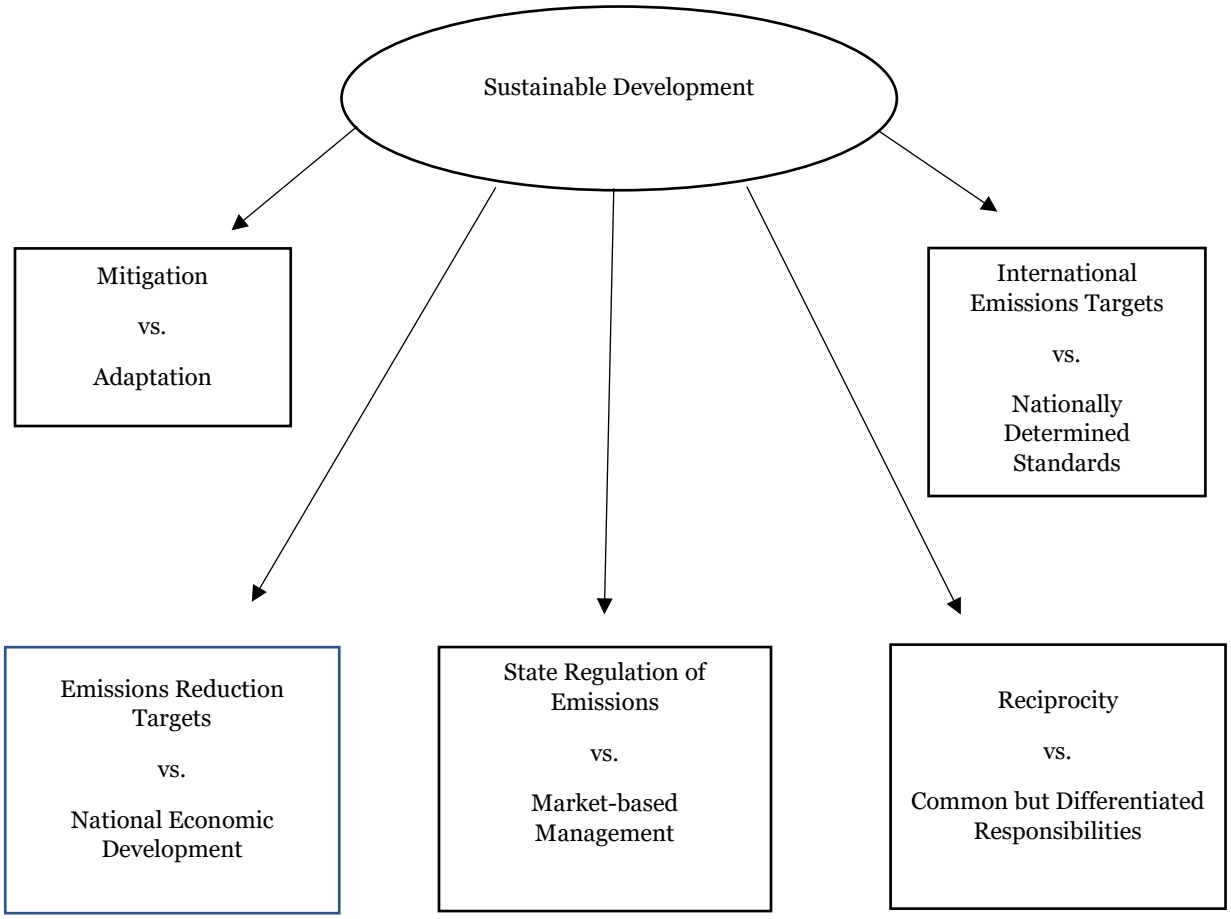
Since the UNFCCC and the Rio conference, sustainable development has emerged as the dominant principle of the international climate change regime complex. All of the agreements regarding climate change make reference to sustainable development as both an objective, and as a standard to assess parties' obligations to the agreement. According to Barral, it is a legally significant concept for state conduct as "undeniably a very powerful hermeneutical tool in the hands of judges, as it can be used to weigh on the interpretation of existing norms."[29] The question, however, is how is sustainable development to be interpreted by states in regards to climate change? The UNFCCC's reference to the principle is influential, but is also fairly ambiguous. Barral's analysis of international agreements using the term finds that its internationally-accepted meaning is based on two principles: intergenerational equity and intragenerational equity.[30] Intergenerational equity refers to the principle that states have an obligation to preserve the environment for future generations. The principle of intragenerational equity, however, also creates an obligation for states to support fair economic and social development within states and among those states in different stages of socioeconomic development. These two principles must then be integrated to fulfill the commitment to sustainable development.

In the area of climate change, a variety of norms have emerged to provide potential pathways for sustainable development within the context of climate change. These norms, however, have also been in competition with one another. Harris and Symons, for example, identify three contests that have developed in international climate change.[31] One contest is essentially between a state-based approach or a market-based approach (or neoliberal) to climate change policy. Both the Kyoto Protocol and the Paris agreement use national production-based emissions targets; however, they also permit market-based emissions trading as means of flexibility for states to go beyond these targets. Another contest is between reciprocity and common, but differentiated responsibility. The contest is whether reciprocity should be specific with the same or equivalent obligations by the individual parties or if the diffuse form of reciprocity of common, but differentiated responsibility based on the collective obligations of the group would be the more effective principle for cooperation in this area. Although the Paris Agreement has

muted common, but differentiated responsibility to some degree, the principle is still acknowledged in the agreement. The third contest is between emissions-reduction targets and national economic development. This conflict is central to applying the concept of sustainable development to climate change. Emissions-reduction of GHG is a necessary condition to manage global warming, but such restrictions may constrain economic development, which may also be necessary for some poorer states to incorporate efficient mitigation measures.[32]

In addition to these norms identified by Harris and Symons, the post-Kyoto climate change negotiations have also demonstrated another contest between the "top-down" approach of international standards of emissions targets and the "bottom-up" approach of nationally determined, or "voluntary" measures. While the Paris Agreement represents a shift to a norm of self-regulation, the "top-down" approach had received a great deal of acceptance in global environmental governance for a number of years. The different strategic approaches of mitigation and adaptation could also be considered a normative contest within sustainable development. The norms discussed in this section are all represented in the primary international agreements governing climate change. The contests between these norms within sustainable development and climate change can be found in Figure 1.

Figure 1: Norm contests within the Sustainable Development Principle in International Climate Change



DEVELOPING A GLOBAL HEALTH SECURITY NORM FOR CLIMATE CHANGE

As discussed, the international legal foundations for climate change are the UNFCCC, the Kyoto Protocol, and the Paris Agreement. In the UNFCCC, the term "health" is mentioned only twice in the treaty. It appears in Article 1 as part of a broad definition of "the adverse of effects of climate change" and again in Article 4 on states' commitments to take climate change into account in formulating their policies.[33] While these articles demonstrate an acknowledgment of the connection between health and climate change, health is not a distinctive term. In Article 1, the reference to health also includes ecosystems and socio-economic systems as part of the effect of climate change. The commitment under Article 4 includes effects on the economy and the quality of the environment as well as health. In comparison, the Kyoto Protocol does not include any mention of health in its terms. The Paris Agreement brought back the use of the term health in regard to "the right to health" in the agreement's non-binding preamble. This reference, however, was in regard to states' taking health into account when making policies to address climate change, not an acknowledge that climate change had an adverse effect on health as was stated in the UNFCCC. Overall, in international agreements on climate change, health has not been given much consideration, and has received very little attention since the early 1990s.

In addition to the international treaties, the connection between climate change and health has not been well established diplomatically in the United Nations system. Kirton, for example, found that at eight major UN summit meetings between 1992 and 2012 the link between the two issues did not receive any increased attention, and the use of science as a justification for the connection was only cited at one meeting.[34] In comparison, they found that attention at the UNFCCC's meetings was even less with COP making no link between 2005 and 2009 despite growing scientific consensus. The main reason for this failure is largely due to the diversity of membership at these meetings in addition to the UN system's structure that separates the institutions of climate change (UNFCCC) and health (WHO).[35]

Within the UN system, however, the WHO has sought to become a more active participant in the global climate change discussion in recent years. The WHO held its first conference on health and climate in 2014, followed by a second conference in Paris in 2016 after the adoption of the Paris agreement. The third conference in 2018 launched an initiative on climate change and health in small islands developing countries. To support this theme, this conference took place in Fiji, Mauritius, and Grenada. The WHO also served as a collaborator for the 2017 Global Health Summit in Bonn, Germany as a parallel conference to the COP 23 meeting, and the 2018 Global Health Summit during COP 24 in Katowice, Poland. At COP 24, the WHO facilitated a report on health and climate change. Despite the lack of direct attention to health in the Paris Agreement, this report referred to it as "potentially the strongest health agreement of this century."[36] While the WHO has been making great strides in terms of advocacy and raising awareness of the climate change and health connection, it is a relative newcomer to the international climate change politics and its impact is constrained by the lack of recognition of health in international agreements.

Perhaps even more significantly, a number of studies support a strong scientific consensus of the deleterious effect of climate change on human health.[37] These findings can provide some compelling evidence as to how and why climate change can be framed

as a health issue. However, within the context of the environment, and more specifically the issue of climate change, what exactly would constitute a global health norm? Such a norm would likely need to be rooted in global health law, which Gostin defines as "the study and practice of international- both hard law (e.g., treaties that bind states) and soft instruments (e.g., codes of practice negotiated by states)- that shapes norms, processes, and institutions to attain the highest standard of physical and mental health for the world's population."[38] Norms have both a constitutive function, which refers to the attachment of identities and interests to the norm, and a regulative function, which refers to setting a standard for appropriate or legitimate behavior.[39] They may be embodied in hard law instruments, but norms are generally associated with non-binding soft instruments.

Using the analysis of framing as a persuasive device, the first step in developing any global health norm for climate change is to address sustainable development. Because sustainable development has become such a defining feature of the international climate change regime complex, health must not only be framed to become part of the core of sustainable development, but it most also be framed as a more distinctive concept within this paradigm. This process is not an easy one for a couple of reasons. First, as noted, the relationship between health and sustainable development is complex. The challenge is for health to become a central part of this principle with which it is not completely aligned. Second, sustainable development has many different dimensions. The SDGs include 17 targets for the world to reach by 2030. The SDGs are a holistic approach to development. While many of these goals relate to health, only one of the SDG goals directly addressed health. The inclusion of good health as a SDG is an advantage for framing health as part of sustainable development's identity. The inclusion of health as only 1 of 17 goals, along with health not being included as a target for climate change action, however, does create a challenge in distinguishing health as a feature of the international climate change regime complex.

Another issue relevant to framing has to do with the ambiguous nature of sustainable development. Although sustainable development has become an accepted and established standard, it has not had much of an impact on state behavior because of its changing content in international political discourse, which Hadden and Seybert describe as a norm with a "failure to launch."[40] In other words, it has not fully established its regulative function. This issue has positive and negative implications for global health within the context of sustainable development. The ambiguity of the concept can lend itself to the possibility of framing health as a core element of sustainable development. On the negative side, however, the ambiguity will also intensify the process of norm contestation where health will have to compete with other norms within sustainable development generally, or climate change more specifically.

In terms of norm contestation, a prospective global health norm faces its most difficult challenge from neoliberalism, which emphasizes the primacy of the market and market-based solutions to environmental problems. While both health and sustainable development may not necessarily be incompatible with neoliberalism, their goals may also come in conflict with it. Neoliberalism's emphasis on the market and individual autonomy and responsibility may not be suitable for health in relation to climate change. For health to grow as a norm in this area, it must be competitive with neoliberalism in gaining political support. It will be important to emphasize positive economic rewards from improved health and better climate in the argument. Such benefits could include

potential declines in morbidity and mortality to improve workforce productivity and reduce health care costs as well as prospects for further economic growth in the renewable energy industry in the long-term. These arguments can be used to help offset criticism that implementing more aggressive measures to address climate change will have a negative impact on employment and national economic growth.

Such a task will present a challenge to the status quo. An analysis by Ciplet and Roberts led to their claim the UNFCCC regime has largely shifted to a neoliberal path.[41] In assessing the Paris Agreement, for example, they find it is influenced by marketization with an emphasis on the private sector as a main actor for mitigation and adaptation measures facilitated by government incentives. The Paris agreement's reliance on disclosure as a regulatory mechanism with a weak compliance mechanism is also consistent with neoliberal governance.

As noted in the discussion on framing as a persuasive device, norm entrepreneurs face significant obstacles in framing climate change as a health issue against norm antipreneurs who can defend neoliberalism as part of the status quo of the international climate change regime complex. To counter this argument, I suggest a framework with an emphasis on human security has the most promise as a constitutive norm for health in this regime complex. The relationship between health and security has often emphasized extreme events such as global pandemics and biological attacks. Security based approaches have not proven to be adequate in addressing health threats related to climate change.[42] The indirect and subtle nature of the relationship between climate change and health may make a traditional security framework suboptimal. Such a frame would run a risk that it could be perceived as exaggerating the impact of the issue, and limit its effectiveness in the discourse of international negotiations. Indeed, as Scott has found, some resistance to the norm of climate security has been the argument that climate change is much more of an environmental issue due to the lack of evidence linking it to violent conflict.[43]

Coupling security with human rights, however, could serve to both enhance the recognition of climate change as a threat, while at the same time presenting it as one based on a universal danger to human well-being, not just environmental harm. As the relationship between health and security has been increasingly recognized with such international institutions as the 2005 revised International Health Regulations and the 2014 Global Health Security Agenda, health has even stronger roots in the area of human rights. In terms of international law, health entrepreneurs have the WHO Constitution with its objective of "the attainment by all peoples of the highest possible level of health" under Article 1, and the Universal Declaration of Human Rights and the Covenant on Economic, Social, and Cultural Rights, which both include health as a human right, to add further persuasive power to a human security argument.

While promising, using a human security framework does have potential drawbacks. As with sustainable development, human security is an ambiguous concept. In fact, Paris argues that "as a new conceptualization of security, or a set of beliefs about the sources of conflict, human security is so vague that it verges on meaninglessness—and consequently offers little practical guidance to academics who might be interested in applying the concept, or to policymakers who must prioritize among competing policies goals."[44] Another potential problem is security fatigue. As more non-traditional security issues become "securitized," it is possible that securitization may lose it persuasive bite. Global health security has already experienced this issue. McInnes and Rushton, for

example, found that HIV/AIDS seemed to lose attention on the international agenda after its identification as a security issue by the UN Security Council in 2000.[45] Sincere commitment to combat a non-traditional threat can also be problematic as Fidler found that the response to 2014-2015 Ebola outbreak demonstrated that "states did not act if framing infectious disease as security threats was politically persuasive or diplomatically convincing."[46] Ambiguity and security fatigue are significant obstacles for norm entrepreneurs in cultivating a global health security norm for climate change. Strong scientific evidence demonstrating the connection between human health and climate change, persuasive analysis and argumentation highlighting its human and economic costs, as well as appeals to international human rights law and equity will all be necessary for this norm to move beyond the emergence stage.

Taking Advantage of Climate Change's Regime Complex

A potential advantage for norm entrepreneurs has to do with the regime complex for climate change. The lack of hierarchical regulation in this area may be a positive feature for normative change. Keohane and Victor note that regime complexes allow for more flexibility and adaptability including the possibility of forum shopping than a regime dominated by single institution.[47] Norm entrepreneurs' use of soft power tools such as expertise and morality may likely be more influential in a regime that is fairly fluid. Because of the current status quo bias towards neoliberalism, they should also seek to work outside the UNFCCC framework for the time being to cultivate a global heath security norm. The UN climate change agreements do little to provide an identification with health. Although these agreements can still serve a useful purpose of an acknowledgement of global health as part of the regime complex, entrepreneurs should target COP outcome documents, multinational and bilateral agreements addressing climate change outside of the UNFCCC framework, national governments, as well as health and environmental NGOs for developing a global health security norm in this area. The WHO, in particular, could serve as an alternative forum to address this issue as it has authority to take action on global health law and policy.[48] Although to this point, acceptance of a connection between health and climate change has been lacking, a path can be found through effective diplomacy to securitize health and develop it into a more robust part of the discourse and the function of this regime complex.

In terms of utility, even if this norm of global health security successfully emerges through this frame and reaches the stage of a norm cascade, its regulative function is not entirely clear. This norm may promote greater urgency to this problem, but it may not necessarily lead to a significantly different response from the status quo. Mitigation, in particular, is already an accepted practice and has received much attention in climate change agreements. It may be difficult politically to push states to accept even more stringent mitigation regulatory measures based on the Kyoto experience. More support for stronger mitigation measures will also not clearly answer the question of whether international standards or nationally determined standards would be a better means to address this issue. The Paris agreement may be a significant improvement to the international climate change regime complex due to its flexibility. Victor, in particular, finds the "bottom-up" approach and the use of nationally determined standards to be meaningful steps towards deeper and more substantial cooperation over time than the "top-down" approach in the Kyoto Protocol.[49]

Adaptation has received comparatively much less attention, and the Paris Agreement continues this trend as its provisions on adaptation provide less commitment and transparency than those related to mitigation.[50] An advantage for a global heath norm is that health has already been associated with adaptation in climate change's legal framework.[51] An emphasis on adaptation is also a good fit for using a human security approach to health as an effective counter to arguments such as by Goklany, who question the effectiveness of mitigation efforts on health.[52]

The WHO has made a number of recommendations for how an increased acknowledgement of the linkage between health and climate change could benefit adaptation efforts.[53] These recommendations include: the use of climate services to strengthen health information systems and improve surveillance and response to climate-related health threats (i.e., heat waves, extreme storms), and stronger health care facilities to more adequately address the enhanced threats to health by climate change. An emphasis on global health security in this regime complex could emerge as particularly important if international mitigation efforts prove to unsuccessful in halting or reducing the impact of climate change on human life.

CONCLUSION

For health to have more influence in international climate change politics, it must be persuasively framed and argued to policy makers for them to accept it as a powerful norm in this area. A human security framework seems to be a promising approach to enhancing global health's profile and convince relevant actors to accept more robust cooperative measures to combat climate change to protect human health. The security component of the framework creates a sense of urgency for policymakers to act and the human element adds an additional moral perspective to augment an argument's persuasive potential. The adoption and commitment to stronger adaptation measures, in particular, may be facilitated by the general acceptance of a global health security norm for climate change.

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IS CLIMATE CHANGE HAMPERING GLOBAL HEALTH SECURITY?: A REVIEW OF THE EVIDENCE

Andrew Defor and Theresa Valerie Oheneba-Dornyo

The impact of climate change on human health is becoming increasingly evident. Several studies have linked disease outbreaks to climate change within the last decade, re-affirming the threat of climate change to human health and global health security. Although there has been an overwhelming response to climate change through global policy dialogue, many countries have failed to fully implement global climate change mitigation policies with obvious implications for global health security. This article reviews the impact of climate change on global infectious disease outbreaks and proposes an integrated climate change-global health foreign policy framework that bolsters full climate change mitigation implementation for global health security.

INTRODUCTION

Climate change is one of the greatest global challenges today. An increase in global average temperature of 6.4 °C is anticipated by the year 2100 with an upsurge in average sea level rise to 88cm.[1] This increase in average temperature is about nine times the global warming average in the last century. The rate at which the climate is changing is alarming considering the immense impact it has on the survival of all living things. Visible impacts of climate change can be observed today on coastlines, glacier-carved mountains, natural systems, biodiversity, coastal marine systems, agriculture, water resources, health and many others. Climate change continues to rise due to increased carbon emissions into the atmosphere [2], with the top three emitters; China, Europe and the United States contributing to more than 50% of the total global emissions. The changes in climate are suggested to be irreversible for at least a thousand years [3]. Climate change is becoming an increasing concern especially to policymakers and health officials due to the negative impacts it has on human health. Climate change has had a tremendous effect on many diseases including water-borne diseases, cardiovascular diseases, foodborne diseases and vector-borne and zoonotic diseases. The world has seen a tremendous increase in health risks related to climate change over the past few decades. Health issues that already pose a key threat to vulnerable populations are expected to worsen and become increasingly prevalent due to the rising temperatures and changes in climate. Although climate has been long-established to impact human health [4], the intricate link between human health and climate change is still not fully understood in the growing body of evidence. According to the fourth assessment report of the Inter-governmental Panel on Climate Change (IPCC), despite climate change being a global issue, the impacts vary across regions and are most felt by low-income and vulnerable populations [5] due to regional disparities like difference in environmental conditions, economic conditions, and political influence [6].

Significant work has been done to investigate the impacts of climate change on human health. This has been supported with a massive response by various political and policy systems in order to mitigate and increase adaptation of populations to climate change effects. Given the importance of climate change on human health, a

better conceptualization of the problem might be to critically examine current policies and perhaps propose an international policy and framework that could potentially strengthen response and maximize climate change mitigation and adaptation. The aim of this paper is to summarize the evidence on the effects of climate change on Global Health and propose practical policies aimed at mitigating climate change impacts on human health and security.

LITERATURE REVIEW STRATEGY AND METHODS

In order to get a clear understanding of the impacts of climate change on global health, a systematic review was conducted. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [7] were used to carry out this systematic review to address methodologic steps during our literature search (Figure 1).

To find studies showing the association of climate change with human health, the following electronic databases were searched using two sets of keywords in each database; Cochrane, Pubmed, ScienceDirect and Ovid Medline. One set of keywords (Term A) was climate change and terms associated with climate change while the other (Term B) was related to diseases that affect human health. Table 1 shows the complete outline of terms used in the search. The search was based on a growing literature in the past years with no time constraints.

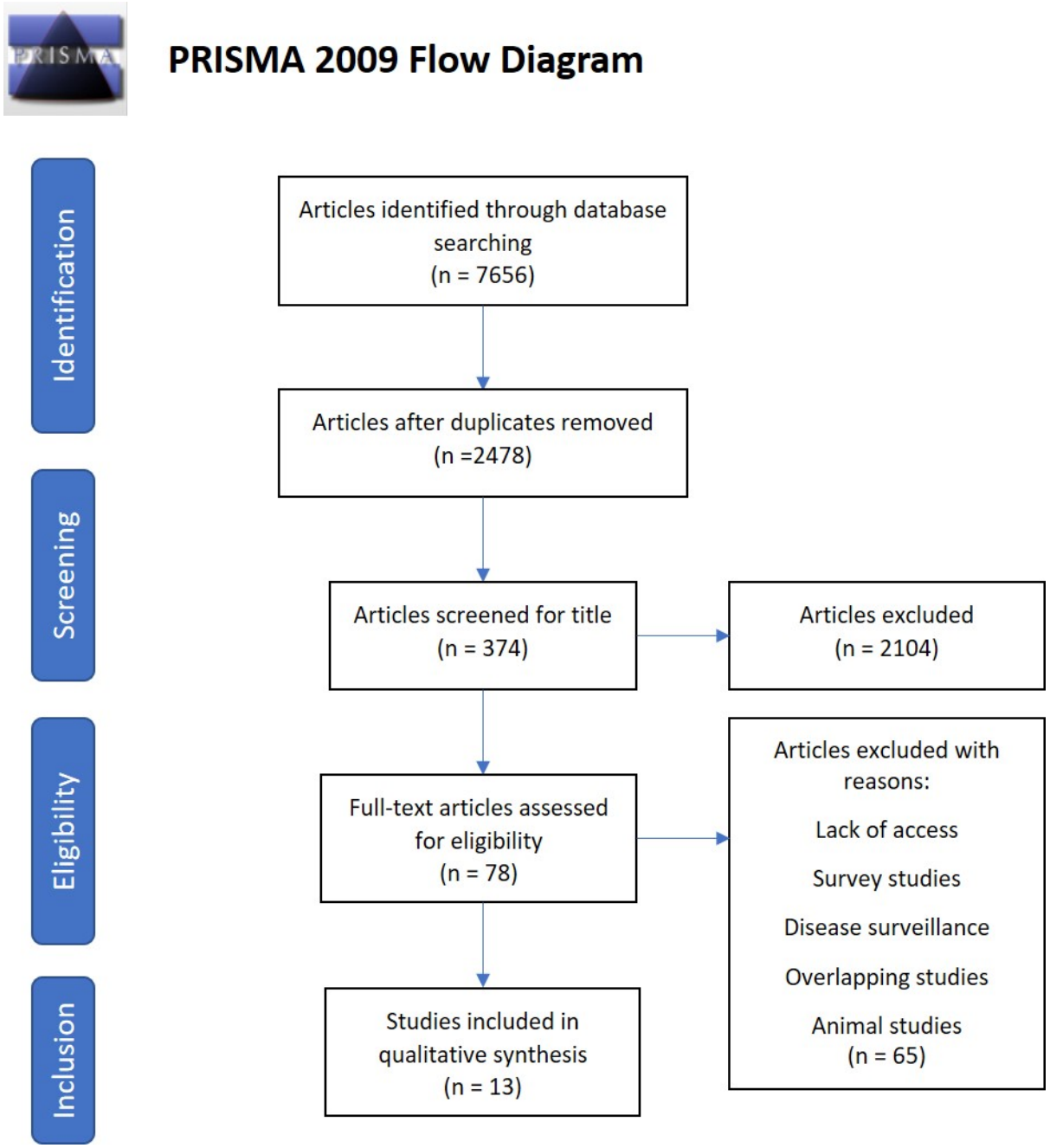
Table 1. Outline of search terms used for systematic review to explore the association of climate change with human health

Concept	Main terms	Other terms
Climate change (A)	Climate change Climate Global warming	Air pollution Temperature Rainfall Precipitation
Human health (B)	Vector-borne disease* Infectious disease* Foodborne disease* Waterborne disease* Cardiovascular disease* Respiratory disease* Neurodegenerative disease*	Mosquito-borne disease* Malaria Tick-borne disease* *Lyme* disease* Dengue *Chikungunya virus* *Campylobacter* *Salmonella* *Escherichia Coli* Non-cholera *Vibrio* species Asthma Chronic Obstructive Pulmonary Disease* Congestive heart failure Dementia Cognitive

To assess the association between human health and climate change, we considered all published epidemiological studies using the following study designs; Randomized Controlled Trials, Controlled Trials, Population-based cohort, Case control and Cross-sectional studies. Articles that did not examine the association

between climate change and diseases that affect human health were not included. Studies that analysed only diagnosis and treatment of diseases were excluded. Studies that examined non-human diseases (animal studies) were also excluded. Publications written in any other language, but the English Language were omitted.

Figure 1: PRISMA Flow Diagram



All articles identified were screened for their title and abstract. Those that did not meet the title and abstract criteria were discarded. Afterwards, the remaining articles that appeared to meet the title and abstract criteria were screened for their full text review against the pre-defined inclusion and exclusion criteria. Studies that did not have the prime aim of examining how climate change influenced human diseases were excluded. Finally, studies that could not be accessed for their full text were

excluded. Data from all potential articles were then extracted using a data extraction tool based on the Cochrane Collaboration and the Centre for Reviews and Dissemination. The following characteristics were extracted from each article: (1) Study design – study name, type of study, geographical location, study duration, climatic factor, disease outcome considered; (2) Key findings – type of association found between climate change and human health. Appendix A provides study details of all included articles.

DATA ANALYSIS

The quality of the selected studies was then assessed using the Critical Appraisal Skills Programme (CASP) [8] checklists for the individual study designs. CASP evaluates internal validity including the credibility of results. It addresses four methodological issues (1) Selection bias (2) Measure of climate change bias (3) Disease outcome bias (4) Accounted confounders. Each study underwent this quality assessment also known as Risk of Bias assessment and assigned a score in accordance with the scoring system illustrated by Barnett and colleagues [9]. A total score ranging from 0 to 4 was then allotted to each study. Low risk of bias (high quality) was represented by 0 or 1, 2 represented moderate quality, while 3 or 4 represented high risk of bias (low quality) (Table 2). A meta-analysis was not conducted in this review due to the heterogeneity of each study in relation to the study populations and study methodologies.

Our initial search generated a total of 7656 articles: 3587 in ScienceDirect, 330 in Cochrane, 405 in Ovid Medline (R) and 3334 in Pubmed. After screening titles, 374 articles were considered for abstract screening. Seventy-eight (78), articles met our pre-defined criteria for inclusion after abstract screening. Lack of access to full texts and irrelevant studies to our study aim led to exclusion of 65 articles. A comprehensive assessment of the remaining of 13 articles for our final review. Five (5) discussed vector-borne diseases, 5 food and water-borne diseases, 3 cardiovascular and respiratory diseases and 1 mental illness. Some of the articles focussed on more than one group of diseases.

DISCUSSION

The objective of this analysis was to examine the impact of climate change on diseases that affect human health and propose an international policy framework that could mitigate these impacts on global health while identifying the vulnerability of current policy. At the time of our review, only 13 articles that met our predefined criteria and were accessible to us explored the association between climate change and diseases that affect human health. All the included studies demonstrated a negative association between climate change and diseases influencing public health.

Table 2. Study Quality of Prospective studies examining climate change and diseases that affect human health

		Measurement Bias			
Study	Selection Bias	Climate Change Measure	Disease Measure	Confounding Variables	Overall (0-4)
Waits et al (2018)	Y	Y	Y	N	1
Wu X et al. (2016).	N	Y	Y	N	2

Götschke, J. et al. (2017)	N	Y	Y	Y	1
Medlock JM and Leach SA. (2015).	N	Y	Y	Y	1
Walker JT. (2018).	N	Y	Y	N	2
Rice et al. (2014)	N	Y	Y	N	2
Cheng et al. (2019)	Y	Y	Y	N	1
Semenza JC and Suk JE. (2018)	N	Y	Y	N	2
Mohammad and Fatemah (2017)	Y	Y	Y	Y	0
Wu et al. (2015)	Y	Y	Y	Y	0
Lake IR (2017)	N	Y	Y	Y	1
Smith & Fazil (2019)	N	Y	Y	N	2
Fischer et al. (2013)	Y	Y	Y	N	1

0 and 1 shows high quality, 2 shows moderate quality, 3 and 4 demonstrates low qualityN, No; Y, Yes

ASSOCIATIONS BETWEEN CLIMATE CHANGE AND DISEASE

Vector-borne diseases

Vector-borne diseases including malaria, Zika, *Lyme* disease, *Dengue* fever, yellow fever, and *Chikungunya* presently account for more than 17% of all infectious diseases [10]. Although vector-borne diseases are preventable, nearly 50% of the world population is infected with at least one type of vector-borne pathogens [11]. Vector-borne diseases have resulted in large number of mortalities across the globe with malaria for example contributing to more than 400,000 deaths annually - majority being children under five years [12]. Most vectors thrive in warm, humid climates, and for this reason among other factors such as poverty, and inadequate health services, tropical regions face the highest burden of vector-borne diseases. The distribution, reproduction and developmental cycles of vectors are influenced by variation in temperature and rainfall [13] and may lead to changes in geographical distribution, transmission season and pattern of diseases, ultimately resulting in new and emerging health issues. An increasing scope of evidence has shown that although in the past, vector-borne diseases have been recorded in various climates and regions, there is an increasing number of people in cooler regions like the US being affected with vector-borne diseases that would typically be found in warmer regions (CDC). Almost 400% increase in reported Lyme disease cases has been recorded in European endemic areas in the last three decades[14].

It is evident that the higher rates of infections are often followed by periods of higher temperature [15] and precipitation [16]. Rising summer temperature is expected to reduce developmental rate periods for most parasites therefore leading to increase in transmission. Lyme disease cases are rising annually in the UK [17] while the distribution of *Ixodes Ricinus*, the primary vector, continues to increase both latitudinally and altitudinally in some areas of Scandinavia and in the ALPS respectively. Although extreme heat, particularly in the summer, coupled with dryness is unfavourable for most vectors including ticks, milder wet winters and warmer springs are also characteristics of climate change that could potentially lengthen winter tick activity and densities. According to Medlock and colleagues, a 2°C increase in temperature could lengthen vector season by one month and upsurge their geographical range of

favourability by 25% to 35%. Most vectors require a minimum temperature threshold of 20°C to result in outbreaks [18]. This means that any further increase in temperature could escalate already increasing rates of vector-borne diseases to outbreaks.

FOODBORNE AND WATERBORNE DISEASES

The most significant climate change impact on human health is proposed to be on food systems, food security and food safety [19]. Climate variables like air temperature, water temperature and precipitation alter the prevalence of foodborne and waterborne diseases by changing the abundance, growth cycle, developmental cycle, and survival of pathogens. The outcomes include changes in water quality, water quantity, and transmission of some diseases. Some food-borne and water-borne diseases including *Campylobacter, Salmonella, Escherichia Coli* and non-cholera *Vibrio* species have demonstrated potential effects of climate variability. A series of studies, as mentioned in a review by Smith and Fazil, in several countries including Canada, United Kingdom and other European countries have reported strong associations between air temperature, water temperature with these diseases [20]. Additionally, incidence in food and water-borne diseases have been observed to rise in the summer and during warmer weather periods [21]. This increased risk of gastrointestinal and diarrhoeal diseases is because the associated pathogens are affected by daily maximum temperature, seasonality and precipitation [22]. Walker and colleagues report in their review that increased rates of diarrhoeal diseases were recorded after a heavy rainstorm or flooding. In the United States of America, a 41% rise in average annual incidence of vibrio infections between 1996 and 2005 was reported [23]. Even areas that had no prior records of vibrio incidence and climate warming have begun reporting infections from these pathogens.

RESPIRATORY AND CARDIOVASCULAR DISEASES

Cardiovascular diseases (CVD) are suggested to be the largest causes of mortality in the world today [24]. Climate change is associated with certain primary air pollutants like ozone, black carbon and particulate matter. These pollutants account for most cardio-pulmonary and respiratory diseases or deteriorating pre-existing conditions [25]. Rice et al., in their review found that wildland fire smoke exposure in the United States, Europe and Australia was linked to asthma and Chronic Obstructive Pulmonary Disease (COPD) hospitalizations, congestive heart failure and general mortality. It is proposed that a 1°C increase in temperature could potentially increase wildfire risk by two to six-folds [26]. Higher levels of air pollutants especially particulate matter in warmer climate has been found to result in greater mortality in comparison to the same level of air pollutants in cooler climate. This implies that increasing temperature has a tremendous impact on cardiovascular and respiratory disease rise and mortalities [27] and exacerbates pre-existing conditions such as chronic lung disease [28]. The significant associations between temperature (heatwaves) and cardiovascular and respiratory mortalities cannot be overlooked [29]. As little as a 1% increment in maximum temperature is associated with 4.27% increase in CVD mortality [30].

MENTAL HEALTH (NEURODEGENERATIVE) ILLNESSES

Although we could not access many articles studying the relationship between mental health and climate change, we found that a few recent studies tackled that aspect of human health and therefore we consider it important to touch on the subject. These

studies suggested that persistent high levels of air pollutants associated with climate change particularly ozone and fine particulate matter could be exacerbating the rate of neurodegenerative diseases like dementia connected with old age [31] and potentially pre-dementia in young adults (mild cognitive deficiency). Exposing patients with both high and low textile of PM_{10} showed that high textile PM_{10} has a more pronounce effect on Alzheimer's disease [32]. Although evidence is limited, we observe the potential impact of climate change on neurodegenerative diseases is high and may even lead to pre-dementia in young adults.

FRAMING THE CLIMATE CHANGE CRISIS AS A GLOBAL HEALTH CRISIS

It is clear from numerous studies, that Climate Change, directly or indirectly affects health outcomes [33]. Since the current international framework has not succeeded in effectively mitigating climate change because of the lack of a basis for a direct sense of urgency, a new global framework could be developed. This new framework will frame the Climate Change Crisis as a Global Health Crisis. Using the Climate Change-Global Health Conceptual framework to frame Climate Change as a Global Health Emergency will create a sense of shared vulnerability, and a sense of shared fate.

The new framework will communicate the idea that the climate change crisis is a global challenge with the potential to negatively affect virtually everyone on the planet. This new approach will increase efforts and responses by everyone from the national to the international level, since the negative health outcomes of climate change affects everyone. Developing a framework that links the Climate Change Crisis to a potential Global Health Crisis will indicate that climate change affects human lives more readily and requires immediate attention. The new framework will help in shifting the perspective on climate change effects from a largely ecological and meteorological base to one that focuses on the human health consequences of climate change. Better responses from local, national and international communities are likely to occur if Climate Change is framed in this way and better resolutions to climate change will result.

USING FOREIGN POLICY AS A TOOL IN MITIGATING CLIMATE CHANGE

Climate change is a global challenge that calls for global solutions. Climate Change is also not just global. It is also very multidimensional, invisible, unpredictable, and moves beyond national borders. Therefore, what is needed is a holistic tool that can properly integrate this new Climate Change - Global Health Crisis framework into all national and international levels for an immediate and effective response to the crisis. Foreign Policy is the main tool that fits this criterion. This is because there has been a recent surge in the incorporation of health in the foreign policies of most of the major carbon emitter countries. Global Health linked issues have risen to some of the highest levels of many of the world's local, political and global institutions[34]. Linking Climate Change to Global Health through foreign Policy will therefore make Climate Change - a Global Health issue-which means more attention to climate change at all political levels. Most developed countries are beginning to take Global Health very seriously[35] and are using their foreign policies to force other countries to also address Global Health related issues[36]. Linking Climate Change to Global Health or framing the Climate Change Crisis as a Global Health threat is likely to elicit a better response from states in committing to making the mitigation of climate change a reality. Foreign Policy can also provide the increased funding[37] and attention, which this new framework needs to succeed. The use of a Foreign Policy approach to mitigate global

health related issues has chalked successes in the past. It was used to effectively mitigate a global issue that was somewhat not health related - tobacco[38].

The new international Climate Change-Global Health Crisis Framework will therefore explore ways in which an integrated climate change-global health foreign policy approach might improve prospects for a more effective global climate change regime. Such a regime would cover actions to mitigate or adapt to climate change in the near and long term. One main feature of this framework which can be adopted by the highest international body in the world-the United Nations Security Council, will be to demand that, all countries to have foreign policies on Climate Change and Global Health. This can augment the current efforts underway in Paris to have an international binding agreement that would see wide global participation following the 2012 expiration of the Kyoto Protocol[39]. This feature of the framework is important because, the climate change crisis is not just an environmental issue, but is also connected to fundamental social, economic and geopolitical issues like health. Many decisions of critical importance for the global climate and for an effective transition to a low-carbon economy will take place outside the climate policy community, in the fields of security, energy, trade and development cooperation-which all have linkages to health. Therefore, only Foreign Policy and diplomacy can effectively transcend these complex-interconnected global fields in order to communicate and implement the new framework. Framing the climate change crisis as a global health threat through using the foreign policies of states will reveal new opportunities to align goals across various international and national policy areas. It is also more likely to bring a broader constituency and greater effectiveness to efforts to tackle the problem.

Using a Foreign Policy approach to implementing the new framework is necessary because, there is an increasing realization within the global community that achieving the consensus and commitment needed to take stronger action on climate change, with all major emitting countries participating in the solution, requires positioning climate change in a broader policy context-such as health. The climate change negotiations obviously do not take place in isolation from other developments on the global agenda, and actions in other areas of foreign policy like health will have impacts on climate change and influence negotiations in the climate change sphere. Because a threat, such as climate change, is not the fault of any one "hostile" power, a new approach that uses foreign policy in combination with climate change and global health concepts is required to effectively tackle issues that transcend national borders. Integrating climate change into Global Health - foreign policies could enhance the ability and willingness of nations and the international community to meet the challenges of climate change. An integrated climate change–global health foreign policy approach has the potential to improve prospects for more effective efforts to address climate change at the national and international level.

PROPOSAL FOR A NEW CLIMATE CHANGE - GLOBAL HEALTH FOREIGN POLICY FRAMEWORK

Feature 1: Diplomacy and International relations

Adoption of this new framework will create an opportunity for the main health global body-the World Health Organization (WHO) to use international diplomacy and relations[40] to further climate change objectives among all its member states. Foreign Policy employs the tools of international diplomacy and foreign relations; - two critical areas that offer new opportunities for negotiating agreements that can meet climate change policy objectives and deepen national and international commitments to tackle

the global threat of climate change[41].

The WHO is well placed to respond to four areas that are pre-conditions to tackling climate change: an effective multilateral system; a coherent approach to foreign policy-making; integration with trade and economic policy; and integration with development assistance. In order to do this, strong political leadership and strategic engagement is required across the full range of WHO decision-making. WHO has a close and strategic relationship with most of the major carbon emitters. Under the existing regime, the WHO can leverage its influence around the world and can work actively with major Carbon emission producing states like the US, China and India to view climate change as a global health crisis.

Key Recommendations:

The WHO should create, lead and implement a new climate change-global health framework that forces all member states of the World Health Assembly to develop a climate change-global health foreign policy by 2030. The foreign policy should clearly support the concept that- climate change is a global health crisis.

Feature 2: Energy Security

Energy Security has been a top foreign priority for most of the world's largest carbon emitters, since energy drives most of the advanced economies [42]. Energy foreign policy can be used as a platform to explain the need for more attention to the implementation of the Climate Change- Global Health framework, since most of the energy sector depends on healthy individuals to manage, explore and operate large energy plants and industries[43]. Framing Climate Change as a global health risk with possible threats to global energy security will cause developed countries- the major emitters of carbon to raise Climate Change to a top priority on their national agendas.

Key Recommendations:

The International Energy Agency (IEA) should openly support the new WHO climate change- global health foreign policy framework. The IEA should also declare Climate Change as a threat to energy security and champion this message internationally. IEA should promote the idea that climate-unfriendly actions will have negative effects on global energy security. They must reinforce this message by encouraging all IEA member states to sign the 2015 Paris Convention agreement which enjoins all IEA states to compulsorily reduce carbon emissions in line with the Kyoto Protocol. This move should be championed as providing dual benefits for the energy industry and global health.

Feature 3: Human Security

The link between, health, human security and foreign policy is very important globally[44]. Any threat to human security through any means whatsoever, always draws attention and countries usually use foreign policy to influence other countries in moving human security-related issues to the top of the agenda in the other country. This is because health threats know no borders. There is now some consensus that negative climate change health outcomes can influence human security[45].

Human security shifts the focus from the level of mankind and the state, where much of the climate-change negotiation takes place, to the level of the individual and community, where much of the impact of climate change is being experienced. At this level, the incentives to mitigate and otherwise address climate effects can be far more immediate, and hence more likely to catalyze behavioral change and effective commitments. Framing Climate Change as a global health risk with possible threats to human security will cause international and local actors to see the effects of climate change at the individual level, and will increase the sense of urgency about mitigating the crisis. The "security link" conveys added, and arguably necessary, impetus to the debate on climate change; and an appreciation of the security implications of climate change could give a renewed seriousness to the climate change mitigation agenda.

Key Recommendations

The United Nations Security Council (UNSC)- the United Nations body concerned with Human Security, should openly support a new WHO climate change-global health foreign policy framework. The UNSC should also declare Climate Change as a threat to global human security and champion this message internationally. The Council should promote the idea that climate- unfriendly actions will have negative effects on global human security. They must reinforce this message by issuing sanctions to any UN member state that refuses to sign the 2015 Paris Convention agreement.

Feature 4: Trade and Investment

Trade can be used as a foreign policy tool in putting pressure on countries to enhance their efforts in mitigating climate change. Since most of the largest carbon emitters rely heavily on trade and foreign investment, any threats to trade will cause governments to take climate change more seriously. There is evidence that Global Health influences trade[46], and therefore, a threat to Global Health is likely to be a threat to trade between countries. Since climate change can cause the spread of pandemic diseases which can be global health problems, framing Climate Change as a global health risk with possible consequences for trade, will cause an improvement in international and local efforts towards mitigation.

Key Recommendation

The World Trade Organization should declare climate change as a global health risk with possible repercussions for Trade. This will force Large Carbon emitter countries-who are members of the WTO, to move climate change to a higher priority agenda.

FUTURE RESEARCH DIRECTION AND DEVELOPMENT

Further research needs to be done on the actors, institutions and policy processes that are required to make the new framework a reality. This paper does not explore how country foreign policies can be structured in order to incorporate dual climate change-global health concepts. More research needs to be done in this area. Future research will have to explore how various national and international actors can use their foreign policies on global health in directly influencing other countries like Canada, that 'are

on the fence' with regards to climate change. Case studies of success stories like the framework Convention on tobacco control, that was successful in mitigating tobacco usage through the concept of global health foreign policy should be explored. A lot of lessons can be drawn from the Tobacco process and used for the UNFCCC agenda on Climate Change. More research would need to be done on how the barriers within local and international institutions can be broken using the climate change-global health policy framework.

CONCLUSION

Our research shows clear evidence of a link between climate change and a variety of infectious diseases. Several studies link disease outbreaks to climate change within the last decade, confirming the threat of climate change to global health security. For the first time, we propose an integrated *climate change global health-foreign policy framework* that frames the climate crisis as a global health security issue through a foreign policy lens. This will increase the severity of the climate crisis among national governments and ensure countries go through full implementation of global climate change mitigation policies and commitments with eventual mitigation of climate change impacts on global health.

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COMPARTMENTALIZED CRISES? UNDERSTANDING THE RELATIONSHIP BETWEEN CLIMATE CHANGE DISCOURSE AND GOVERNANCE OF INFECTIOUS DISEASE

Summer Marion

While health and climate science recognize a clear linkage between infectious diseases and effects of climate change, outbreaks and disasters are frequently framed as standalone crises in public discourse. Drawing on public policy image framing literature, this paper examines effects of crossover in climate change and infectious disease discourse on policy outcomes in global infectious disease. Employing Factiva coding, I conduct a statistical analysis of infectious disease discourse and its effect on the global health policy agenda between 1990 and 2019. I find a positive relationship between climate change framing of infectious disease and global policy outcomes, significant at the 0.1 level, alongside qualitative evidence that securitized and environmental framings may have mutually reinforcing effects in elevating infectious disease on the global policy agenda.

INTRODUCTION

Despite an overall decline in mortality from infectious disease, recent decades have witnessed an increased prevalence of global infectious disease emergencies. Reforming institutions to govern such crises presents a collective action problem—one which sparked some of the earliest modern global cooperation—yet incentivizing disease surveillance and reporting continues to plague health governance institutions following each new outbreak. Concurrent with this uptick in global health emergencies, public debates over the ramifications of another collective action problem—climate change—intensified. While public opinion remains polarized, acceptance of scientific findings linking climate change to weather-related disasters has become more commonplace in public narratives. Similar to the linkages connecting climate change and disasters, it is difficult to prove direct causal links between climate change and specific outbreaks. Scientific evidence clearly supports a systemic linkage between the two trends, yet this connection rarely makes its way into public discourse.[1]

Policy advocates often adopt strategies of re-framing collective action challenges, garnering support for change by defining problems in a more publicly accessible manner. In outbreak response, this is seen in securitized narratives of health, in addition to other framings including economics and human rights. Noting the normalization of public discourse linking climate change and disasters, this research investigates the power of environmental framings in garnering support for global health emergency reform. In this vein, this study examines overlap in public discourse between infectious diseases and climate change, asking whether and to what extent environmental framings of infectious disease have implications for global governance policy outcomes.

To address this, I employ data aggregating media and policy documents relating to infectious disease between 1990 and 2017 to conduct a content analysis of infectious disease image framings, including security, economic, human rights, and environmental

discourse. I consider convergence of these framings with windows of major global reforms for health emergency response—including World Health Organization (WHO) structural reforms and establishment of new UN bodies and major UN partnerships—to assess whether certain framings are more or less associated with global policy outcomes. I initially hypothesized an inverse relationship between climate and security framings over this time. Based on previous findings, I anticipated security narratives would act as broker framings for health emergency reforms, which frequently occur following crises. While securitized frames are often combined with other narratives, I hypothesized climate-related narratives could play the role of broker frames as well, but only under conditions when policy discourse proved more consequential to policy change than media coverage. My findings suggest this hypothesis was partially correct. Security frames dominated media coverage of infectious disease throughout the period of study, second only to the baseline medical framing, presenting with an initial significant spike around the 2002 SARS outbreak. While the increased attention drawn through securitized narratives certainly contributed to keeping infectious disease issues high on the global governance agenda, I find no evidence that securitized narratives acted as policy broker frames. Instead of displacing environmental framings, they often present as reinforcing frames, concurrent in cases of global governance reform. I find limited evidence, however, that environmental narratives may play a role as broker framings in global governance of infectious disease reform. This novel contribution lays the groundwork for future studies further exploring the changing role of climate and environmental discourse in global health.

HEALTH SECURITY AND THE CLIMATE CRISIS

At the root of image framing narratives of infectious disease is the much-studied securitization of global health, or discourse presenting the issue in terms of threat or risk.[2] Initially regarded as an useful framing for drawing needed funding and attention to fighting infectious disease, many scholars have argued that the simplification inherent to these narratives bears long-term costs, and often renders them ineffective.[3] Yet securitized narratives are frequently combined with other framings. This is exemplified by the 2002 outbreak of Severe Acute Respiratory Syndrome (SARS), which marks the initial spike of the securitization era. The SARS outbreak heralded a new kind of infectious disease response in which the network of professionals engaged in response diversified to include sectors beyond the medical community.[4] Global public discourse regarding infectious disease followed suit, reflecting the many facets of public life affected by health crises—including economics, security, and human rights. During this time, as internet access became globally prevalent, ownership of public discourse assumed new meanings, and the general public gained access to information previously limited to policy circles. In the case of SARS, securitization narratives combined with economic ones dominated, driven by the WHO travel advisory to China, and related economic losses. The years following SARS saw the 2005 creation of the International Health Regulations (IHR), the body of international law governing infectious disease prevention, outbreaks, and response, of which WHO remains the custodian. This era relatedly led to a new designation for global infectious disease emergencies: Public Health Emergency of International Concern (PHEIC).

Recent years have seen increased securitization of climate narratives; *climate crisis* is fast becoming a preferred term of reference by many news outlets, replacing earlier terms such as *climate change* and *global warming*.[5] Alongside this shift, recognition of systemic links between climate issues and infectious disease is growing. While links between climate change and certain prevalent infectious diseases, such as malaria, have long been recognized, a new acknowledgment of systemic links between climate change and global disease outbreaks began to develop. Climate change and infectious disease are both multifaceted systemic issues, and thus the manner in which these linkages occur varies broadly.

In some cases, the link is directly tied to global temperature increase which broadens the physical environment conducive to spread of disease. This has been extensively researched in the case of vector-borne diseases such as malaria and Zika virus, transmitted by mosquitoes which thrive in warm temperatures.[6] In other cases, linkages are more complex. Respiratory diseases such as SARS and Middle East Respiratory Syndrome (MERS), for example, infectious rates have been linked to sharp temperature changes which weaken the human immune system.[7] Other key linkages focus on human population growth and displacement of wildlife due to environmental destruction and urbanization, thus forcing animals carrying zoonotic diseases in closer proximity to humans.[8] Such complexities undermined the validity of earlier narratives that climate change might in fact prove helpful to containing influenza epidemics common in the cold winter months.[9]

Increasing presence of these linkages in public discourse raises questions regarding their relationship to global policy change. This research thus examines infectious disease narratives in media and policy discourse between 1990 and 2017. This period of study was selected based on data availability, to account for a rise in infectious disease discourse over the span of the 1990s, concurrent with both the rise of the internet age and the HIV/AIDs pandemic, which preceded the first spike in coverage in the early 2000s. While spikes in media coverage present concurrent with declared infectious disease emergencies (PHEICs), this study accounts for all infectious diseases listed as causes of mortality in the Global Burden of Disease report.[10] Major reforms are more likely to occur following crises, yet the crisis dynamic associated with securitized narratives is relatively new to coverage of both climate change and infectious disease. Malaria, for example, has never been declared a PHEIC yet is among the longest-studied linkages between climate change and infectious disease.

EXISTING LITERATURE

Previous research suggests that common explanations such as variation in mortality and financial burden do not adequately account for the variance in policy attention attributed to issues in global health governance.[11] This body of work suggests image framing as a better explanation for the manner in which global health issues ebb and flow within the policy agenda.[12] It draws upon public policy literature, which devotes ample attention to exploring the politics of agenda setting – the mechanics behind rise and fall of certain issues to which policymakers devote resources. Image framing fits within this body of work, falling broadly into two categories: one focusing on generic frames used across multiple issue areas, and another examining issue-specific frames.[13] Underlying such studies is the idea that problem definition, or the manner in which an issue is portrayed,

is a fluid concept which can be manipulated by policy advocates, resulting in varying perceptions of policy problems by both policymakers and the public.[14] Due to its malleable nature, image framings of a policy problem are not mutually exclusive. An issue may be portrayed in a manner employing multiple framings at once. This study focuses on issue-specific frames, examining variation in problem definition within the global governance issue area of infectious disease response.[15]

Image Framing and Infectious Disease

Image framing narratives common to the studies of global health include medical, security, economic, and human rights narratives, often employing biomedical discourse as a baseline frame.[16] Past studies have found that effectiveness of framings in influencing individual opinions is often disease-specific.[17] When considering how framings effect policy outcomes, existing findings emphasize the importance of audience—especially in public health, where policy interventions are frequently determined by experts with specialized knowledge.[18] In addition to these established image frames, this research examine the prevalence and effects of an environmental narrative of infectious disease response on global governance policy outcomes.

Security Framings

Securitization, a theoretical paradigm emergent from the Copenhagen School, frequently studied in image framing analyses of infectious disease, presents a policy problem in terms of threat or risk.[19] This type of frame frequently occurs around crises or other focusing events, which some findings across policy issue areas suggest increase the likelihood of legislative change.[20] Early analysis of securitized health narratives argued they hold potential to act as "broker frames," sidestepping demonization of those with opposing viewpoints to spur reform.[21] More recent findings indicate the simplistic nature of these narratives encourages stigmatization and detracts from effective health policy outcomes.[22] Security framings are consistently present in infectious disease narratives, spiking notably high in times of crisis. As this applies to global governance, and global health in particular, Hanrieder and Kreuder-Sonnen have theorized international organizations with the power to define crises—such as the WHO in declare a PHEIC—can created an "emergency trap" dynamic, catalyzing reform.[23] Securitized narratives are frequently combined with each alternative framing included in this study—and given their prevalence, often co-opt the narratives with which they coexist. Yet windows for innovative governance and policy change following crises pose challenges to establishing a causal link between securitized narratives and policy outcomes.

Economic Framings

Though securitized framings of are on the rise, narratives drawing on health economics have long played a key role in portrayals of infectious disease. Economic discourse is frequently employed in epidemiology, notably in discussion of burden of disease; the term *burden* itself implies cost, which may be measured in various dimensions including social, public health, and financial dynamics.[24] Studies of economic narratives in other issue areas have found them to act as broker frames in influencing

individual attitudes.[25] Economic framings of infectious disease frequently occur in terms of cost-benefit analyses of prevention versus response. Otherwise stated, what is the cost of maintaining surveillance and reporting mechanisms, and what effect do such reforms have on mitigating economic losses associated with infectious disease crisis? While some studies have found economics to be an effective framework for influencing individual attitudes in cases such as SARS, many such findings are disease-specific rather than generalizable to infectious disease more broadly.[26] Many studies exploring alternate infectious disease image framings cite the inadequacy of economic explanations in accounting for variance in global governance policy attention.[27]

Human Rights Framings

Infectious disease framings invoking the concept of health as a human right frequently present concurrently with securitized and economic narratives. Such narratives typically arise in the context of humanitarian response and development aid for health. They have been found effective in influencing attitudes and opinions in disease-specific contexts including HIV/AIDS.[28] Given the preponderance of discourse related to health as a human right in public health practice and scholarship, this narrative is nearly universally included in image framing studies of public health. Yet its prevalence in public discourse is notably low in comparison with the security and economic narratives of infectious disease.

Environmental Framings

By adding an environmental frame to commonly studied narratives of infectious disease discourse, this study explores the shifting role of linkages between infectious disease and climate change in global health governance agenda setting. Previous work on image framing of climate change indicates that public health narratives tend to arouse hopeful emotions in individuals.[29] This research seeks to understand the inverse relationship—environmental narratives of disease—and the effect of those narratives on global policy outcomes. Many expected health effects of climate change are systemic rather than disease-specific, relating to well-being and lifestyle factors including poverty, displacement, and access to resources.[30] This study addresses such systematic linkages, including a range of search terms to address climate narratives as they relate to these issues. As climate framings have become increasingly securitized,[31] I anticipate significant overlap between environmental and security narratives of infectious disease.

METHODS

The aim of this study is to determine whether some of these narratives are more associated with major reform than others, and if so, by what margin. Given this variation in infectious disease narratives, I employ an auto-regressive statistical model to test the effects of different framings on major global governance policy outcomes relating to infectious disease. My study includes narratives commonly employed in image framing studies of health politics, as well as a novel environmental framing to test the effect of emergent narratives connecting climate change and health. I restrict the period of study to 1990-2017. Infectious disease narratives were predominately biomedical prior to the

1990s, thus my data present with few observations prior to this timeframe. Data availability for key control variables is limited beyond the year 2017, thus I do not extend my analysis to account for subsequent years. To test these quantitative findings, I employ content analysis of news articles and policy documents to produce a composite case study examining three major spikes in infectious disease discourse.

Guided by previous studies applying image framing concepts found in public policy literature to health politics, I conducted a search of Factiva records for predominant infectious disease framings over the period of my study. [32] Search terms used to capture infectious disease were developed to include both general terms such as "infectious disease," "epidemic," and "pandemic," as well as disease-specific terms drawn from infectious diseases listed in the Global Burden of Disease report.[33] These were searched in tandem with terms for each image frame, which included key phrases intended to produce conservative estimates of coverage for that year. For example, search terms for the environmental framing included "climate change," "greenhouse effect," and "sea-level rising," among many others. These data were collected through an iterative process in which I developed a list of key search terms for each frame, qualitatively assessed the quality of the search results, and expanded or contracted the list accordingly over multiple iterations.[34]

Raw article counts for each framing, with duplicates removed, constitute key independent variables. The dependent variable in this model is global governance reform, including new partnerships related to infectious disease and emergency response adopted within the year. This includes WHO structural reforms and changes to the IHR, as well as new organizational bodies created through WHO partnerships. The model additionally includes multiple control variables to account for geopolitical events and other factors that may have swayed infectious disease narratives in a given year. As previous studies have noted that mortality fails to adequately account for variation in global policy attention, the model controls for global mortality from infectious disease in a given year. Global climate change milestones including major summits and legislation constitute and additional control, as well as major climatological disasters which may generate elevated climate narratives. To account for crisis dynamics generated by major health emergencies, I include a health emergencies control variable which encompasses declared or considered PHEICs as well as the SARS outbreak, which led to the creation of PHEIC designation. A list of primary dependent and control variables, along with their measurements, is provided in Tables 1 and 2.

Table 1: Dependent Variable

Variable Name	Definition	Source
Global Governance Reform	Dummy of important global reforms regarding infectious disease response, including World Health Organization structural reforms related to emergency response and creation of new UN bodies or major UN partnerships	Case study analysis

Table 2: Control Variables

Variable Name	Definition	Source
Health Emergency	Dummy of Public Health Emergencies of International Concern (PHEICs) either declared or considered for declaration, in addition to the 2002-2003 SARS outbreak	World Health Organization; case study analysis
Mortality	Dummy of annual global mortality from infectious diseases included in search terms	Global Burden of Disease Database*
UN/COP Milestones	Dummy of important climate change summits, legislation, and resolutions internationally	UNFCCC for Climate Change**
Disaster	Dummy of environmental disasters that caused over 40 deaths internationally	EM-DAT for Disasters***

*Source: *Global Burden of Disease Collaborative Network http://ghdx.healthdata.org/organizations/global-burden-disease-collaborative-network **UNFCCC for Climate Change https://unfccc.int/ ***EM-DAT, CRED / UCLouvain, Brussels, Belgium (D. Guha-Sapir) www.emdat.be*

DATA ANALYSIS

Consistent with previous studies, the vast majority of infectious disease framings are characterized by either medical, security, or economic narratives. The data account for a 28-year period and skew heavily right due to the spike in policy discourse around infectious disease in 2002. Descriptive statistics for all variables are listed in Table 3.

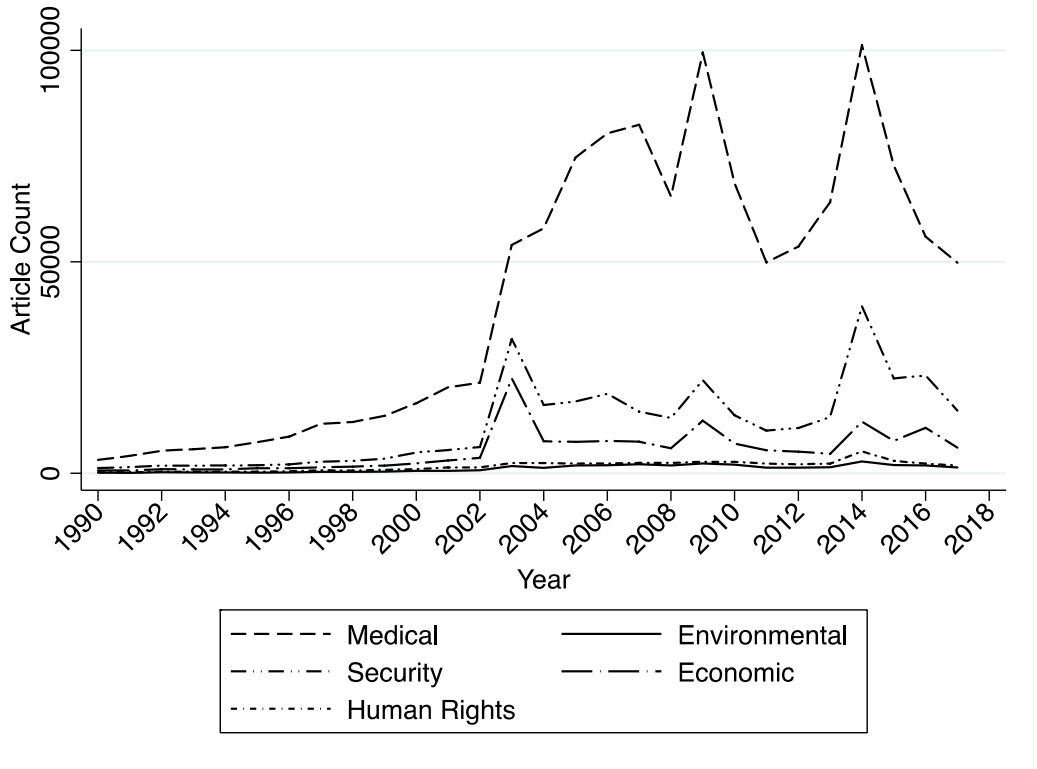
Table 3: Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
Variables	N	mean	sd	min	max
Medical	28	41,662	32,126	3,175	101,193
Environmental	28	1,135	828.7	139	2,815
Security	28	11,403	9,976	1,250	39,512

Economic	28	5,378	4,877	664	22,433
Human Rights	28	1,697	1,157	247	5,181
Health Emergency	28	0.321	0.476	0	1
Mortality (millions)	28	10.410	1.141	8.142	11.51
UN/COP Milestones	28	0.286	0.460	0	1
Disaster	28	0.536	0.508	0	1

The data present with collinear spikes around major health crises. Some of the increase over time for all framings is also due to the advent of accessible internet, which augmented the raw quantity of public discourse. Due to collinearity, the model unfortunately cannot accommodate this control. Trends in issue frames across the period of study are illustrated in Figure 1.

Figure 1: Infectious Disease Across the Years (1990-2019)



In terms of raw article count, the baseline medical framing outnumbers the rest, presenting more than three times as frequently as the second-most prevalent framing, security. Beyond that, the security narrative dominates, more than doubling the raw article count for economic framings. Human rights and environmental narratives unsurprisingly trail far behind. The descriptive statistics also make apparent the manner in which gaps in narratives develop around major crises. The medical baseline framing notwithstanding, key narratives of infectious disease remained somewhat comparable in prevalence throughout many years of the 1990s. Gaps between them grew significantly beginning with the 2002 SARS outbreak. Removing the medical framing, Figure 2 illustrates the breakdown in average presence of other key image framings across the

years. Security framings account for more than half, followed by economic framings at around one quarter, and finally human rights and environmental framings constituting the remainder.

Figure 2: Infectious Disease by Framing Type (average across years)

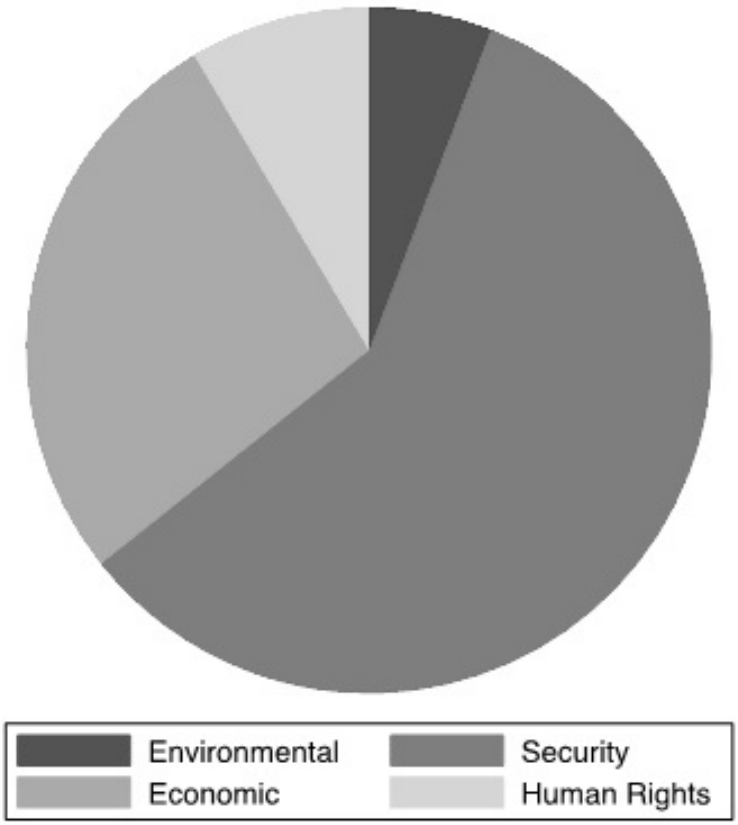


Table 4 presents the regression results for a model fitted to measure relationships between each framing and major global governance reform across the period of study. This model presents relationships between each narrative present in the data and major reforms, while controlling for important co-variants suggested in the literature. Given previous findings, this study is designed with particular attention to environmental framing as a key independent variable. Indeed, beyond the baseline medical framing, the environmental frame is the only independent variable presenting with statistically significant results, demonstrating a small positive association with reform at the 0.1 level. Yet the medical baseline framing as well as the control variable for mortality appear to be better predictors of reform, each presenting with small negative associations.

Table 4: Predicting Global Governance Reform Based on Infectious Disease Framings

Variables	(1) Global Governance Reform	(2) Sigma
Medical	-4.07e-05**	
	(1.72e-05)	
Environmental	0.00160*	
	(0.000913)	
Security	6.57e-05	
	(6.32e-05)	
Economic	-8.44e-05	
	(0.000107)	
Human Rights	-0.000524	
	(0.000589)	
Health Emergency	0.0126	
	(0.446)	
Mortality	9.66e-07**	
	(4.30e-07)	
UN/COP Milestones	0.0651	
	(0.173)	
Nine Eleven	0.292	
	(0.732)	
Disaster	-0.298	
	(0.246)	
Constant	-283.2**	0.300***
	(121.3)	(0.0816)
Observations	28	28

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These results, while promising, should be interpreted with caution. The malleable nature of image framing narratives presents inherent challenges to quantitative analysis. Given that this model treats years as observations (N=28), it can accommodate only a limited number of co-variants, leaving a high potential for omitted variable bias. Additionally, all key independent variables analyzed here are collinear in nature due to overarching trends in infectious disease coverage. I thus offer these results as exploratory findings, and delve into the relationships they reveal through qualitative case study analysis.

CASE STUDY: TRENDS IN INFECTIOUS DISEASE IMAGE FRAMING, 1990-2017

This composite case study presents qualitative analysis of trends driving three major spikes present in infectious disease narratives over the period of study. While each spike

clearly occurs around the onset of a global health emergency – the 2002 SARS outbreak, 2009 H1N1 pandemic, and 2014 response to the Ebola outbreak in West Africa – this analysis looks beyond crises driving news coverage to examine variation in relationships between infectious disease narratives and policy outcomes. Qualitative findings suggest that security and environmental narratives may be mutually reinforcing in elevating infectious disease on the global health policy agenda.

SARS, 2002-2004

The 2002 outbreak of SARS defined a well-documented paradigm shift in global health governance. Prior to this time there was no formal mechanism for declaring a global health emergency. Thus, following the outbreak's onset in late 2002, the WHO took an action many argued overstepped its mandate, issuing travel advisories for Toronto and parts of China in the spring of 2003.[35] In retrospect this is widely regarded as a key step in preventing SARS from becoming a major pandemic, yet it took place against the wishes of the Chinese government, which feared the economic ramifications of trade and travel advisories. In the aftermath of the SARS pandemic, this action was justified retroactively through codification in the IHR, which was adopted in 2005 and took effect in 2007.[36]

Media coverage surrounding the travel advisory is the primary driver of the 2003 spike, yet interplay among competing narratives reveals a more nuanced story. Medical framings of infectious disease coverage, which had climbed steadily throughout the 1990s, spiked to unprecedented levels in 2003, the year the travel advisory was issued, remaining high through the 2005 adoption of the IHR, and indeed through 2007, when its implementation was finalized. Yet for security and economic narratives, the spike around the SARS outbreak appears even more stark in relation to the crisis itself, though less so in relation to subsequent reforms. Securitized narratives present with a small peak around 2007, otherwise remaining relatively stable albeit elevated from pre-SARS levels. Economic narratives are similarly elevated from the period preceding SARS, and relatively stable during this period.

It is additionally notable that the SARS outbreak occurred during a critical period of global climate change debates, during which news coverage of climate change itself was at an all-time high.[37] The Kyoto Protocol, to which the U.S. was not a signatory, had been signed in 1997 and would not take effect until 2005. Behind this spike in the interim years was an interplay between positive and negative economic framings of climate change driven by the international community and U.S. government under the Bush Administration, respectively.[38] The SARS crisis drew unprecedented attention to growing threat from animal transmission of infectious diseases, at a time when the complexities of climate change and its implications relating to wildlife displacement, urbanization, and population density were a key focus of global governance efforts.[39] In the wake of the SARS outbreak, the UN hosted an April 2004 conference focused specifically on prevention efforts related to disease transmission between animals and humans.[40] As scientific understandings of SARS made their way into public discourse, news coverage turned to such efforts at crafting effective policies for prevention.

Finally, a closer look at the policy discourse reveals that sustained attention to environmental narratives is partially attributable to discourse regarding other diseases. While environmental narratives begin to decline after 2007, their period of elevation coincides with the years leading up to the 2008 launch of the Rollback Malaria

Partnership Global MalariaAction Plan.[41] During 2002-2004 spike in infectious disease framings, security and economic frames remain dominant alongside conventional medical narratives in discourse describing the SARS crisis in real time. Yet the elevation in environmental narratives beginning near the onset of the outbreak remains present through the year in which the IHR took effect. While the security and economic framings are frequently referenced as "broker frames," their presence drops sharply after 2003. Concurrently, the baseline medical narrative for infectious disease continues to climb until 2006. The environmental narrative, declining slightly after the initial outbreak, then climbs again to remain consistently high between 2005 and 2007. The human rights frame continues a slow increase throughout the remainder of the decade. These patterns suggest that interplay between securitized discourse surrounding crises and major climate-related news stories may create a mutually reinforcing dynamic between security and environmental framings of infectious disease.

H1N1, 2009-2010

The outbreak of H1N1 (known colloquially as swine flu), beginning in early 2009 and lasting through much of 2010, became the first pandemic to put the newly minted IHR to the test. Its quick onset and severity led the WHO to declare the first PHEIC in April 2009. The U.S. concurrently declared a public health emergency.[42] Unlike the case of SARS, H1N1 had widespread global implications, affecting 168 countries by July 2009, in the first few months of the crisis.[43] The pandemic led to widespread criticism of health governance organizations due to an undersupply of the flu vaccine.[44]

H1N1 additionally marked the onset of another epidemic in which animal to human transmission played a key role in public discourse. While H1N1, like other flu viruses, is easily transmitted between humans, many studies uncovered evidence of transmission between humans and animals, and vice versa.[45] In the pandemic's wake, assessment of the H1N1 response fell to the nascent IHR Review Committee.[46] While the review covered global, national, and state-level response plans, emphasis was on strengthening response at the country level.[47] The H1N1 pandemic drew attention to regional, country, and local-level challenges of IHR implementation, leading to efforts to double-down on previously passed reforms.

While considered a pivotal crisis in global health policy, public discourse regarding H1N1 falls within a narrower scope than that relating to the SARS crisis. Reflecting widespread coverage of the vaccine shortage, medical narratives spike notably, reaching their second highest peak over the period of this study. Security and economic narratives increase less markedly than in the case of SARS. Security narratives are noticeably lower than might be expected given the significance of the first PHEIC designated outbreak. This relative discrepancy may be attributable to a normalization of H1N1 by a public audience accustomed to annual influenza. Relatedly, economic narratives in particular are less dominant during this crisis than during SARS, when they reach their highest peak. Environmental framings reach their highest peak yet at the onset of H1N1, and their second highest during the period of study, appearing to reflect displacement narratives connecting climate change with new dynamics characterizing human to animal disease transmission. Concurrently, human rights narratives undergo a smaller bump and plateau during the 2009-2010 period.

In a notable similarity to environmental narratives surrounding SARS, the 2009 onset of the H1N1 pandemic coincided with a major spike in general climate-related news coverage in the lead-up to the Copenhagen Climate Summit (COP-15), held in December of that year. While the model presented in this study controls for major climate summits and legislations, qualitative evidence reveals some overlap in coverage of the climate summit and H1N1, indicating this contributes to the uptick noted in descriptive statistics for the environmental narrative. It may be that securitized health narratives acted as reinforcing frames in support of climate action, as the two issues made headlines throughout much of that year.[48]

Ebola and Zika, 2014-2016

The 2014-2016 Ebola outbreak in West Africa – the worst in history, claiming over 11,000 lives[49] – is the primary driver of the spike occurring between 2014 and 2016, a period during which public discourse relating to infectious disease reached record highs. This period is in fact characterized by two peaks: a primary spike in 2014, heavily driven by coverage of Ebola, followed by a smaller peak in 2016 around the time of the Zika outbreak. While security narratives dominated public discourse, the 2014 peak marks the highest point during the period of analysis for every framing other than Economics, which peaked in 2003 at the height of the SARS crisis. Originating in Guinea and Liberia, and soon thereafter in Sierra Leone, transmission spread to include a small number of isolated cases in the US and Europe.

Securitization of Ebola came about in part through this geographic dynamic, as transmission identified cases of the disease in the U.S. and Europe contributed to the uptick in global news coverage. Exemplifying securitized discourse, the *New York Times* article covering the October 2014 case in Texas announced, "With New Ebola Case Confirmed, U.S. Vows Vigilance."[50] It is noteworthy that unlike SARS, which can be transmitted easily between individuals, Ebola transmission requires close contact with bodily fluids. Yet fear of Ebola, with a 50 percent fatality rate, stoked a stronger securitized narrative than witnessed during SARS.[51] In that vein, the Ebola outbreak notably marked the first instance in which an infectious disease crisis was referred to the UN Security Council, which in September 2014 unanimously passed a resolution calling on states to contribute more resources to the response effort.[52] In addition to contributing to the securitization of Ebola, this explains the peak in human rights framings contemporaneous with the crisis.

In addition to Ebola, this period encompasses two other PHEICs. A resurgence of Polio in Afghanistan, Pakistan, and Nigeria, endangered prospects for eradication of the disease and was declared a PHEIC in May 2014, though garnered little media attention. Additionally, as previously noted, in early 2016, the WHO declared its fourth PHEIC due to the spread of Zika-virus in the Americas. Zika, which unlike Ebola is not considered fatal, marked the first mosquito-borne disease to be declared a PHEIC.[53] A smaller uptick in coverage is notable in 2016, driven primarily by coverage of Zika. In 2016, security and economic narratives are again higher than they were in the preceding year. This shift is barely notable in the trendline of baseline medical framings, registering only as a deceleration in the decline following the Ebola crisis. While the Environmental and Economic framings continue to decline, they also experience notable decelerations presenting as plateaus during this period.

Environmental narratives relating to the Ebola crisis were driven by narratives of both wildlife displacement leading to transmission between animals and humans, and global temperature increase. Of note, the Paris Climate Summit (COP-21) and negotiation of the Paris Agreement to reduce the effects of climate change took place in November of 2015, contributing to reinforcing climate and health narratives. Leading up to the summit, French environment minister Ségolène Royal made headlines with a public comment suggesting that deforestation and displacement of bats, which may carry Ebola virus, "may have started West Africa's Ebola outbreak."[54] Media coverage of the 2019 PHEIC declared due to the Ebola outbreak in Democratic Republic of the Congo and Uganda, while outside the timeframe of this study, demonstrates further integration of scientific findings linking climate change and Ebola in public discourse.[55]

In response to criticism that the global community was slow to act during the Ebola crisis, while still in the midst of the Zika PHEIC, the World Health Assembly adopted the Health Emergency Programme (HEP), the largest structural reform in WHO history, in May 2016. At first glance, securitization narratives, which dominated the spike in media coverage during this period, appear to be a key driver of this change. In a 2015 article in *The Lancet*, Bill Gates exemplified security as a broker frame, calling for a health emergency reform to create an institution akin to NATO.[56] The provision of the HEP mirror this call, broadening the WHO mandate in times of crisis. Converging medical and security narratives are potential drivers of reform in this case. Yet the pattern across major spikes in infectious disease discourse cases suggests that windows of opportunity for reform may occur when securitized environmental narratives coincide with climate advocacy surrounding key summits and legislations. Environmental framings remained elevated throughout the Ebola crisis and adoption of the HEP, mimicking the pattern observed following SARS. It is more challenging to draw conclusions in this case, however, as the HEP was adopted concurrently with the 2016 Zika PHEIC.

CONCLUSIONS AND IMPLICATIONS

This study presents exploratory findings suggesting environmental discourse may play a role in elevating infectious disease crises on the global health policy agenda. While I initially hypothesized securitized frames would act as broker frames, the security narrative does not stand out in my empirical findings. I do, however, find qualitative evidence that it acts as a bridge framing facilitating reform processes. These results corroborate findings suggesting securitized framings of infectious disease, while key in garnering public attention, do not act as broker frames driving reform—but may act as a catalyst in combination with other policy narratives prevalent during times of crisis.[57] To a degree they support the concept of an "emergency trap" dynamic in reform driven by international organizations. As I employ a broadened concept of reform extending beyond the WHO, it is difficult to draw a direct comparison. Yet my findings offer a complimentary explanation encompassing reforms within a broad swath of global health governance institutions, and suggesting how reinforcing frames might interplay with security narratives.

Each spike in media coverage explored in the case studies coincides with a global public health emergency, yet not all crises are followed by major reform. Security and economic narratives were generally better aligned with baseline medical framings, spiking in reaction to crisis events. The environmental narrative is notable in that its

fluctuations do not adhere as closely to crises. It appears instead to act as a reinforcing frame when major climate summits and legislations coincide with disease crises. In the case of IHR adoption following the SARS crisis, environmental frames exhibit persistent elevated presence throughout both crisis and reform. This pattern suggests that the sequence and combination of key narratives, as opposed to the unique frames identified in the literature, may act as brokers for policy change. The interplay between infectious disease crises and related but slower-moving global policy processes such as climate negotiations may play a key role in driving environmental discourse trends. Earlier studies of issue framing in health crises also suggest this may be tied to audience.[58] In other words, environmental frames are more compelling to health experts responsible for driving policy change than they might be to the general public. This hypothesis is worthy of further qualitative exploration in future research.

These findings contribute to understandings of issue framings beyond security applied to global health emergencies in public discourse. They additionally highlight the need for future case study analyses to trace causal mechanisms of infectious disease image framing, with particular attention to environmental image framings. Interplay between infectious disease crises and reform, and global climate advocacy surrounding major summits and legislations is a trend revealed in the case study warranting further attention. Future research should examine these linkages more closely, perhaps broadening its scope beyond the questions of policy change and individual attitudes typically covered in image framing research to address questions of aid effectiveness. In particular, including proxies for donor preferences as well as geocoding in future analyses may present a more nuanced picture of interactive dynamics between public discourse and other key variables—thus painting a clearer picture of the relationship between environmental discourse and the global health policy agenda.

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CAN WE WEATHER THE HEALTH RISKS OF CLIMATE CHANGE AMIDST POLITICAL INSTABILITY?
EVIDENCE AND LESSONS FROM FRAGILE- AND CONFLICT-AFFECTED STATES

Yara M. Asi

The needs of fragile and conflict-affected states (FCAS) are usually framed in terms of humanitarian or security aims. As a result, health security in FCAS is poor. Yet in the background of these competing forces is the approaching threat of climate change. This paper will evaluate the impact of climate change on health security related issues in FCAS. I will first assess how environmental trends may impact the health outcomes of the civilians in FCAS using state-level data. Next, I will describe the barriers that limit FCAS from addressing their health and climate change risks. Lastly, I will outline policies that can be undertaken in the absence of political settlement to protect civilian health security from the threats of climate change.

INTRODUCTION

The current global inaction on the issue of climate change is at odds with the near certainty of the scientific community, over several decades, that global warming is a reality and is a result of man-made action[1,2,3,4]. Former President of the United States of America Barack Obama called climate change an "urgent threat," the current Secretary General of the United Nations Antonio Guterres calls climate change an "emergency," and Pope Francis considers it "the most serious and worrying phenomena of our time." This is terminology typically associated with war or terrorism, but the looming nature of climate change has given it the distinction of being perceived as the world's biggest security threat, even more than the threats of ISIS or North Korean nuclear missiles[5].

At the same time, global carbon emissions reached an all-time high in 2018 and continue to grow, limiting our ability to reduce global warming levels to a manageable 1.5-2 degrees Celsius[6], despite climate models dating from the 1970s tracking consistently with observed warming over time[7]. By the middle of the 21st century, some of the world's most populated cities will be unlivable[8]. Similarly, it is thought that armed conflict and terrorism are to some extent predictable[9], but with both war and climate change, the international community has consistently failed to meaningfully engage with evidence-based practices that would reduce threats to human well-being.

Changes in temperature, precipitation, and sea level over the long-term may increase frequency and intensity of floods, droughts, heatwaves, famines, and epidemics. Widespread poverty as a result of the collapse of agricultural systems in developing countries that depend on them for economic growth, weakened states unable to keep up with demands on infrastructure, and an additional push factor for mass migrations are all threats to human security that are intensified by climate change[10]. We know these outcomes, or worse, are on the horizon. Unfortunately, it is the countries least responsible for climate change and those least able to respond that are most likely to experience the

worst outcomes. Developing countries and even the most vulnerable people in industrialized countries (such as children, poor people, minority groups, people with disabilities, women, and the elderly) are at greatest risk for the environmental and health consequences of climate change, including threats to their human rights. These include the right to life, food, water, and health[11]. These threats are even more evident in fragile and conflict-affected states (FCAS), where human rights and access to health are already precarious.

This paper will address how climate change serves as an amplifying factor to the health security risks that already exist in FCAS. After a brief discussion of the specific barriers to FCAS in addressing climate change-related risks, I will propose several evidence-based recommendations for how to spend limited resources on building resilience and stability in these environments. While at first a moral and humanitarian imperative, it is also important to consider that these populations are on the frontlines of what is likely coming for even the most stable states and privileged communities within them. If we cannot learn how to adapt before some of the more widespread and catastrophic consequences emerge, there will not be time to slow or reverse greenhouse emissions and pollutants before policy solutions become inadequate.

HEALTH RISKS OF CLIMATE CHANGE AND CONFLICT

Addressing this layered topic means it is important to start with the three issues (health, climate change, and conflict) and their linkages. The question here is not "does climate change cause conflict?" or "what are the health risks of climate change?" as these questions have been widely debated in the past and are briefly discussed below. I am asking a different question: for those populations already living in FCAS, what are the health risks that climate change presents or amplifies? There is little research connecting these three issues together, but disparate studies do suggest that there are linkages that demand attention[12]. Effective global governance on this issue has been lacking, and resources are scarce. We must try to understand the challenges of the most vulnerable populations among us to avoid widespread humanitarian disasters. The International Committee of the Red Cross (ICRC) recently issued a statement echoing this imperative: "The question we are most often asked about climate change is a causal one: whether and how it leads to conflict. The one that really matters to us now, however, is how it affects the populations with whom we are already working, people living in dire situations of conflict or violence"[13]. This question serves as the foundation for this paper.

Existing Threats to Health in FCAS

Situations of mass violence and armed conflict pose enormous threats to health and well-being in the form of direct threats to the body, as well as secondary outcomes of conflict, like displacement, malnutrition, and disease. Through bombings, drone strikes, shootings, and other forms of violence, civilians may be killed or injured. These attacks are sometimes intentional as a weapon of war while other events may see civilians suffer as "collateral damage" from a strike aimed at targets perceived as legitimate[14]. A state experiencing lower levels of peace sees considerable reductions in life expectancy, even when controlling for economic indicators and education level[15]. Overall, since World War

II, it is estimated that within 160 wars, 90% of the tens of millions of war-related deaths (total estimates range) were civilians.

The totality of these risks to health security shows that like climate change, the threats presented by war are not limited to one or two vectors of disruption. Living in a conflict-affected environment affects every aspect of an individual's life, compounded by the fact that most of the states classified as "fragile" are also low- or middle-income[16]. According to the ND-GAIN, which measures readiness and vulnerability to climate hazards, all the countries classified as fragile by the World Bank are among the worst scoring on both indicators[17]. The average life expectancy in fragile states is 64.7 years as compared to the global average of 72.4, while the average GNI per capita in these states is only $3764, less than half the global average of $10672[18]. Of the 35 fragile states, 20 are considered "low human development" by the Human Development Index, while another 10 are classified as "medium human development" (Table 1). This adds an additional layer of poverty and poor economic development on the health risks posed by the state's existing fragility and poor governance. This leads to additional risks to public health and strain the resources of humanitarian and relief agencies that work with fragile populations.

Table 1: Indicators of climate vulnerability, development, and health for fragile and conflict-affected states

State	*ND-GAIN 2017*[1]	*HDI 2019*[2]	*LE 2017*[3]	*GNI per capita ($) 2017*[4]
Afghanistan	31.4	0.496	64.5	1746
Burundi	32.3	0.423	61.2	660
Central African Republic	27.5	0.381	52.8	777
Chad	25.7	0.401	54	1716
Comoros	39.2	0.538	64.1	2426
Congo, Dem. Rep.	29.6	0.459	60.4	800
Congo, Rep	34.7	0.608	64.3	5804
Côte dIvoire	37.9	0.516	57.4	3589
Djibouti	38.9	0.495	66.6	3601
Eritrea	26.3	0.434	65.9	1708
Gambia, The	38.3	0.466	61.7	1490
Guinea-Bissau	32.1	0.461	58	1593
Haiti	31.4	0.503	63.7	1665
Iraq	39.8	0.689	70.5	15365
Kiribati	ND	0.623	68.1	3917
Kosovo	ND	ND	72	4275
Lebanon	45.2	0.73	78.9	11136
Liberia	32.4	0.465	63.7	1040
Libya	40.8	0.708	72.7	11685
Mali	33.6	0.427	58.9	1965

Marshall Islands	ND	0.698	73.9	4633
Micronesia, Fed. Sts	36.5	0.614	67.8	3700
Mozambique	35.4	0.446	60.2	1154
Myanmar	34.8	0.584	66.9	5764
Papua New Guinea	35.2	0.543	64.3	3686
Solomon Islands	38.1	0.557	72.8	2027
Somalia	20.3	ND	57	ND
South Sudan	ND	0.413	57.6	1455
Sudan	30.4	0.507	65.1	3962
Syria	39	0.549	71.8	2725
Timor-Leste	41.1	0.626	69.3	7527
Togo	37.9	0.513	60.8	1593
Tuvalu, Rep.	ND	ND	ND	4835
West Bank and Gaza	ND	0.69	73.9	5314
Zimbabwe	33.1	0.563	61.2	2661
Average for all FCAS		*0.535*	*64.8*	*3765*

Sources: Notre Dame Global Adaptation Initiative. Lower score=worse performance for climate vulnerability and readiness; Human Development Index[81]. (UN) Lower score=less development. Average for all developing countries: 0.686; Life Expectancy. (World Bank). World Average: 72.383 years; GNI per capita ($). (World Bank). World Average: 10672; ND= No Data

Climate Change and Conflict

Eight years in, the Syrian Civil War has been one of the worst humanitarian crises in recent memory. As with most conflicts, there is no single cause, but a convergence of pre-existing issues that in this case were ignited by what were at first peaceful protests. However, not overlooked was the fact that Syria is in one of the driest areas of the world. From 2006 until 2011, Syria experienced a long period of droughts and crop failures. Farmers lost their livelihoods, food prices increased, and millions moved from rural countryside to the outskirts of cities where food and water were more available. Many argued that deterioration of conditions in Syria were at least partially attributable to the social stressors placed by drought and an inadequate response by the state[19]. However, recently others have started to question this claim, pointing to long-term trendlines in migration and frustration with the Assad regime[20]. Ultimately, whether Syria was a "climate war" may be impossible to discern. What is clear is the humanitarian catastrophe that persists to today.

This debate is found throughout the climate change and conflict literature. It is difficult to directly tie the indirect effects of climate change to onset of specific conflicts. Additionally, much of the published research focuses on Africa and the lack of standardization on research design makes generalizability difficult. There is also the reality that we may not recognize some of the indirect linkages of climate change to conflict as they occur over the long-term, and so much is uncertain about the future of climate change that we cannot directly extrapolate based on evidence from the past[21]. Based on what is known, in 2015 the G7 released a report[22] entitled "A New Climate for Peace" that identified the seven compounding risks posed by climate change that they

predict will cause state instability: local resource competition, livelihood insecurity and migration, extreme weather events and disasters, volatile food prices and provision, water management, sea-level rise and coastal degradation, and unintended effects of climate policies. Ultimately, climate change may or may not increase conflict, but it does clearly compound the risks to health security present in FCAS by increasing likelihood of humanitarian need. Even in developed states, the health effects of climate change have been documented. These are states with stable governance, intact health systems, and accessible human and financial resources. FCAS begin their response to climate shocks at a deficit as they start with systems that are not built for resilience and populations that are already experiencing significant risks to their health.

Climate Change and Health

While the relationship between climate change and conflict is under debate, there is little doubt that climate change will cause a decline in population health outcomes. Climate change can be directly fatal as we see an increase in extreme weather events. Storm-related deaths may increase up to 50% as severity of storms increases with warming ocean water[23]. Heat-related mortality will also likely increase, especially in cities and for vulnerable populations[24]. However, for most populations, climate change will serve as a "risk multiplier" that exaggerates existing social and political determinants of health. Climate change is predicted to increase poverty, inequality, and resources scarcity at the same time populations are continuing to grow and age[25]. These factors are more likely to contribute to widespread increases in mortality and disability than a specific heatwave, although those are more likely to capture attention and funding. The WHO estimates that between 2030-2050, climate change will cause an additional 250,000 global deaths per year, with between $2-4 billion in damage to health sectors annually[26]. The most significant impacts to health will be concentrated in the most vulnerable populations, including the elderly[27], individuals with chronic illnesses[28], children[29], people with disabilities[30], refugees[31], and women[32], but they have lowest political and institutional power with which to advocate for changes[33].

Our rapidly modernizing world has brought several factors to the fore as the interconnectivity of life today increases. Issues like urbanization, globalization, technology, gender disparities, employment, aging populations, deficits in childhood development, and others have changed not just how and where we deliver healthcare, but what types of healthcare are needed for different populations. In this framework of understanding the totality of social, political, and economic factors on health care, climate change and armed conflict have become significant indicators[34,35]. Both increase demands on health systems, cause extreme conditions where health delivery may be limited, and have ripple effects throughout all factors that make up an individual's quality of life in ways that contribute to health inequities. Neither climate change nor armed conflict are issues to be tackled by one sector or industry. They require comprehensive responses from a panoply of stakeholders.

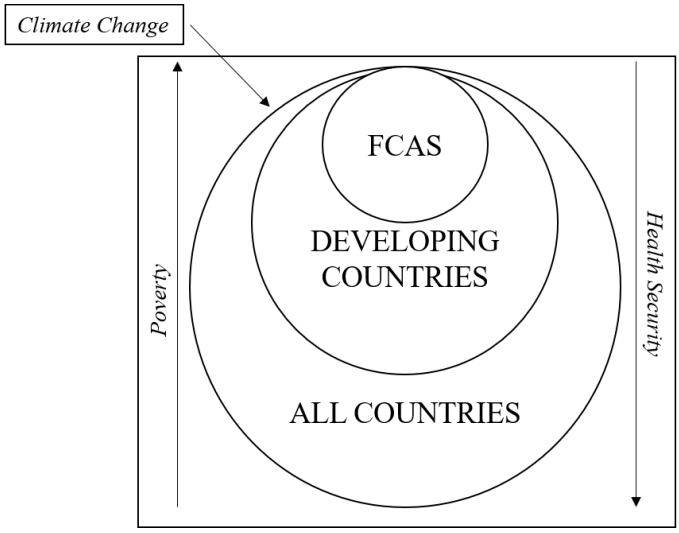
THE COMPOUNDING EFFECT OF CLIMATE CHANGE ON REDUCING HEALTH SECURITY IN FRAGILE POPULATIONS

Stakeholders in global health governance face a significant challenge. Almost a quarter

into the 21st century, we have yet to find that singular innovation that will make it possible for us to reduce global warming while maintaining development and industrialization. This is a seemingly overwhelming, yet relatively new, problem in the overall trajectory of humankind. While much simpler in its mechanism of action than climate change, war has similarly evaded the discovery of effective policy solutions, with the primary innovations being the weapons used and the battlegrounds shifting to more concentrated pockets of developing countries. We also cannot discount the role of poverty, which both increases vulnerability to conflict and climate change and is also an outcome of conflict and climate shocks[36,37]. Illustrated in Figure 1, evidence suggests that FCAS are more likely to experience poverty than developing countries as a whole due to conflict-specific factors. These same factors also contribute to lower health security in these states than we would expect based on socioeconomic indicators.

Through a conceptual review, I have identified the primary focus areas where climate change poses the greatest risks to health security in the fragile or conflict-affected environment. To be clear, this is not an exhaustive list of all the health effects of conflict nor the predicted health effects of climate change; there have been many comprehensive articles written on these topics. Rather, I have highlighted the health risks that already exist in FCAS that will be amplified by the emerging threat of climate change.

Figure 1: Climate Change and Health Security in the Existing Ecosystem of Fragile and Conflict-affected States (FCAS)



Water Security

Already, less than 0.01% of all water on the planet is available and suitable for human consumption, and more than 1 billion people do not have access to safe water. Water is not just used for human consumption but is vital for food production of both plants and animals. Issues with water have increased as trends in urbanization persist, agricultural land is degraded due to misuse, and the effects of climate change, like increased droughts, intensify[38]. Existing water supplies are also under threat from manmade factors, including contamination and terrorist attacks. Water-borne diseases and parasitic infections are already a major cause of mortality worldwide in areas with

unsafe water supplies[39]. Disparities in how rich and poor states build their water infrastructure means that those in fragile states are at increased vulnerability of these threats to water security. These countries are also at higher risk for more long-term weather events, like droughts, that cause migration flows; Oxfam estimates that in just the first nine months of 2017, more than 2 million people were displaced by drought[40].

Many of the world's rivers are shared by more than one country, which has long caused conflicts over water. Water conflicts can be caused by low rainfall and dependency on one water source, high population growth and urbanization, modernization and industrialization, and pre-existing tensions between states[41]. Much of the world is already feeling water stress, and these needs will only increase as population growth and industrialization continue. Water stress leads to poor economic development, migration, and conflict between entities. As populations continue to migrate to urban centers, concerns for water demand will be compounded by concerns about increased water pollution due to development and waterborne disease due to the clustering of populations. Where water will remain plentiful, like the tropics, challenges will shift to ensuring that the water is clean and accessible[42].

Food Security

While intimately related to extremes and variability of water, the threats to human well-being resulting from changes in a changing agricultural climate are high enough to merit their own discussion. Malnutrition and hunger reduce life expectancy and limit quality of life and development. Reversing more than a decade of progress in reducing world hunger, a 2019 report by the United Nations found that 9.2% of the global population (about 700 million people) experienced severe food insecurity, with an additional 17.2% of people (1.3 billion) experiencing moderate food insecurity. Conflict and state insecurity were the major driver of food crises in 21 countries. At the same time, climate variability and extremes are reducing agricultural outputs and food production[43]. Negative climate-related impacts to agriculture have two immediate effects: one, developing countries that are highly dependent on their agricultural sectors will see a collapse in employment as these farming enterprises become more difficult to safeguard against climate-related effects. Secondly, the reduced global agricultural production may lead to food shortages and even famine. Climate change has the capacity to affect food production at all levels, including decreased rainfall, heat stress on farm workers, increased pathogens for livestock, altered fish catches, lower customer purchasing power, declines in pollination, and coral reef degradation[44]. A combination of any of these factors together could be devastating to populations that are already struggling for food.

The cyclical relationship between food insecurity and armed conflict seems clear; evidence suggests that food price volatility and food shortages may encourage conflict[45, 46,47]. As high food prices contribute to more conflict, conflict then increases food prices. Dry conditions themselves are associated with greater conflict due to their effect on food prices[48]. All countries at high risk for famine, including Nigeria, Somalia, and Yemen, along with South Sudan where a famine was declared in 2017, are also experiencing armed conflict[49]. Conflict also reduces the ability of local populations to grow their staple crops and reduces overall agricultural output[50]. As conflicts devolve, food shortages may also then be artificially manufactured by cutting off trade and destroying food stocks and agricultural infrastructure to starve populations, as was widely seen in Syria[51]. Many

states have already seen negative impacts to agriculture due to increased periods of heat and dryness, yet they are the least likely to have the forecasting and modelling technologies needed to respond to potential famine[52].

Infectious Disease

Infectious disease is among the largest threats to global health security; we are inadequately prepared for any outbreak, especially in poor countries, and potential pandemics could cost up to $60 billion per year[53]. The combination of war and a shifting climate in fragile states sets the prime environment for an infectious disease outbreak in a state that is poorly equipped to respond in a way that will prevent transmission across borders. Even in developed countries, infectious disease outbreaks can proliferate quickly, as was seen after Hurricane Katrina in the United States. There is not a long record of tracking climate change-related affects to vector-borne diseases, and the interactions between climatic variables and other factors are not well understood. Climate change may lead to greater risk of deadly infectious diseases, or at least shifts in where these diseases (such as cholera, malaria, and dengue fever) may emerge[54]. Risks of vector-borne diseases will increase in some areas due to warmer climates and wetter conditions but will reduce in others as temperatures stay more stable and conditions are drier[55], increasing risks in populations where health systems are not prepared and humans will have less immunity[56]. Regarding food- and water-borne illnesses, which account for millions of deaths annually, the relationship is slightly clearer in that extreme weather events like floods do seem to increase infectious disease risk[57]. Infectious disease risk is also higher in the conflict-affected environment due to factors like the clustering of people (especially in refugee camps), increased sexual violence, and even potential use of biological weapons[14].

Mental Health

Across contexts, in all environments, regardless of socioeconomic status or level of political stability, mental health has historically been underprioritized by health systems. At least a quarter of the global population will face a mental health issue in their lifetime, many of whom live in developing and fragile states. Additional factors, like poverty, hunger, traumatic experiences, and poor access to care exacerbate the risk of mental health conditions. As is, a small fraction of these populations will ever receive any sort of treatment for their ailment[58]. Without a foundation of mental health, it becomes harder to find or secure employment, pursue an education, or avoid homelessness and incarceration. These are conditions that further decrease a state's economic development or ability to prioritize good governance[59].

Civilians who live in conflict-affected areas as well as the refugees that flee them and the soldiers who fight in the wars are all more likely to experience severe mental health trauma[60]. However, these effects may also be seen with natural disasters and other environmental events. The extreme weather that may increase in frequency as a result of climate change are not just a threat to physical health, but mental health as well, in some ways analogous to the mental health threats from living in armed conflict. Exposure to storm- or flood-damage to one's home may negatively affect mental health, even in affluent populations[61]. Forced or even voluntary migrations due to climate change or an

extreme weather event can have detrimental effects to the mental health of migrants, while natural disasters of all kinds can be very traumatic for residents. Devastation of livelihoods may lead to increased suicide rates, such as with farmers during drought conditions[62].

Risks to Health Infrastructure

Safeguarding healthcare facilities and personnel has become a pressing issue across the spectrum of humanitarian organizations. Despite long-time provisions within international humanitarian law and United Nations resolutions, aggressors have increasingly learned that they can act with impunity in attacking health care infrastructure. In 2017, 23 countries reported attacks on health care, including bombing, looting, abductions, and obstruction. Such attacks reduce health system capacity and public health outcomes due to facility closures, flight of health care workers, lack of resources, increased demands on care, reduced functionality of facilities, lack of care for chronic diseases, disease outbreaks, negative consequences for mental health, and many other mechanisms[63].

Climate change, especially in the form of extreme weather events, also poses significant risk to health care facility infrastructure. Increased likelihood of hurricanes, tornados, floods, wildfires, landslides, and severe heat or cold all pose significant risk to health facilities and workers. Most health facilities are not built to withstand these types of events, and most health workers and communities in even the most stable societies are not prepared for the type of emergency response that extreme weather events will require[64]. In poor countries and fragile environments, health services may be delivered in informal settings that are ill-equipped for any stress to infrastructure or personnel.

INCREASING HEALTH SECURITY IN THE FACE OF CLIMATE CHANGE

The global consensus on how man-made activities are contributing to climate change is relatively new, as is our understanding of the health risks involved. However, many of the states at the highest risk for climate change have already been dealing with conflict and other humanitarian emergencies. Thirteen of the 20 countries at highest risk for climate change-related effects already have humanitarian appeals through the United Nations. In only 3% of projects involved in these humanitarian appeals was there a climate change component, and of these, less than half received funding[65]. Fragile states are also less likely to have incentives to adopt green technologies, less likely to have control of their own natural resources and have little institutional capacity within the state and minimal power on the global stage. In general, it is difficult to procure funding and support for environmental initiatives. However, when framed as a public health issue, support toward climate initiatives may improve. From the health perspective, facing climate change is seen as a win for all humanity, rather than the "zero-sum game in which nations and neighbors must compete" that can be more common in other climate discussions[66].

Despite an overall gloomy picture, we can point to some successes in climate action, including the Paris Agreement, which was perceived as a significant step forward in the global response to climate. The Agreement explicitly addressed the needs of vulnerable populations, calling for financial support, new technology, and a focus on capacity building[67]. However, the Agreement has been critiqued for being non-binding

and depending too much on political pressure to change deeply entrenched structures and industries[68]. Public health and climate professionals feel demoralized by the public's assumptions that climate change is either not a problem or is not a problem that can be solved, or that they simply don't understand just how detrimental climate change will be to human health[69]. As a result, we are caught in the stasis of imposed inaction for those who want to enact significant climate policies because they lack power due to the ideological inaction of those who ignore moral, social, or political imperatives to address the issue due to their own perspectives on markets and the role of governments[70].

There is a tendency to "silo" issues defined as environmental in ways that don't consider how climate change and environmental adaptations work in other areas. For example, out of tens of thousands of studies on the effects of "green infrastructure," less than 20 considered any health or well-being outcomes, with an almost exclusive focus on technical performance. Additionally, almost half of these studies were set in one city: Portland, Oregon, one of the most ethnically homogenous cities in the United States. This offers very little generalizability to other contexts, even on the merits of solely technical considerations[71]. This shows significant gaps where public health officials, providers, and other stakeholders must step in to describe the intersectionality between climate change, conflict, and health. Levy, Sidel, and Patz[72] identify three specific areas for public health professionals to focus: supporting reduction of greenhouse gas emissions, promoting adaptation measures to improve community resilience, and, importantly, addressing the underlying issues where climate change's compounding effects are most harmful, such as with socioeconomic disparities.

Building Overall Resilience

Under the assumptions that climate change will, to some extent, negatively affect life on Earth, and that conflict between and within states will persist, public health advocates should make the case that adaptations and reforms to improve health security cannot wait until resolution on either of these issues is reached. What can we do now with the limited resources allotted to these issues, and especially to the most powerless populations who will feel the worst effects? To reduce the burden of climate- and conflict-related human insecurity, attention must be paid to the overall functioning of a society. Building social capital, especially within the most vulnerable communities, helps reduce the physical and mental stressors that environmental events present to daily life[33]. Maintaining mental health resilience will be vital in allowing these populations to transition in a world threatened by climate change by adapting with sustainable development.

Those states and entities that have contributed the most to climate change should take the lead in developing adaptations and reforms, first and foremost in the manner of providing funding. The Green Climate Fund is an effort established in 2010 by the 194 countries of the United Nations with this goal in mind, focusing on least developed countries, small island developing states, and African states. However, progress has been rocky and there are inadequate processes for raising and distributing money[73]. Streamlining and highlighting the Green Climate Fund and similar efforts is an obvious first step as any meaningful initiative requires financing. Other mechanisms, such as incentivization schemes that pay "rent" to fragile states to offset the cost of them reducing

deforestation (like REDD+), should be under discussion, with attention given to evidence that suggests that payments should go to local agents rather than directly to states[74].

Climate change and health vulnerability and adaptability assessments have become increasingly common but should become the norm for FCAS as well. These assessments have been conducted at some scale for more than 20 years, but in a 2018 review of international progress on these efforts, only 7 of the 35 fragile states have engaged in such an assessment, almost all of which are small island nations (Kiribati, Mali, Marshall Islands, Micronesia, Papua New Guinea, Timor-Leste, and Tuvalu). These efforts need to be treated as an urgent first step so resources can be distributed appropriately, and partnerships can be established to share evidence and strategies[75]. In general, there was not a single health threat discussed that could not be mitigated with predictive approaches and data analytics so we could be prepared for the specific risks that are unique to each locale. While there is significant debate across the literature on climate change and its exact effects, it does seem evident that any changes from climate change will not be uniform. Disease risk may not increase everywhere, but it may increase in places it did not before. Food production may not be completely stifled, but we may lose biodiversity in certain parts of the world. Rain levels will increase in some areas and decrease in others. There is no single algorithm or policy that is solely appropriate, and state-level assessments and planning resources will go a long way in making sure states know what is coming and can prepare targeted solutions.

New Approaches to Technology

Technology will not stave off the worst effects of climate change nor war. In fact, forms of technology have been at the source at some of the deadliest innovations in armed conflict and the largest contributors to greenhouse emissions. However, when applied with outcomes in mind, technology can serve as a useful tool in providing health services to fragile populations. In conflict-affected areas, access to health care can be difficult due to destroyed infrastructure, active violence, and lack of personnel or resources. There are many ways that forms of health information technology (HIT) can contribute to improving health outcomes in these environments[76]. However, there are also environmental incentives for HIT adoption in fragile states. Constantly flying in health care personnel from other areas and flying out local personnel to train in countries with greater resources increases greenhouse emissions due to increased need for travel. Despite the significant need for health records for fragile and displaced populations, using paper records contributes to deforestation. Clearly, a new technology infrastructure, while initially requiring some emission outputs, could also contribute to an overall greener and more accessible health system for global populations. Technologies like telemedicine, remote medical education, remote diagnostics, e-prescriptions, and other forms of HIT could be part of a multifaceted approach to modernizing health care in fragile states while potentially reducing greenhouse emissions and making health systems more resilient[77]. is also significant literature about how technologies are vital in expanding food and water security, increasing mental health access, tracking and preventing infectious disease, and documenting damage to health infrastructure.

Can cooperating on risks to health and climate change build peace?

Thus far, the discussion has focused on improving health outcomes in FCAS with little attention to changing the political situation. Obviously, ending the conflict would do significantly more for health outcomes than any policy measure operating in the conflict environment. However, it is possible that addressing health risks of climate change is not just of benefit to population health, but to the likelihood of building peace as well. In fact, some argue that states working together to deal with the universal risks of climate change to sustaining lives and livelihoods may increase peace and improve humanitarian response[78]. The inequities behind climate change, health insecurity, and conflict are often similar, and there are many interventions that would serve to increase outcomes across all three sectors. Yet, peacebuilding activities often act completely independently of climate change adaptability measures despite evidence that points to relationships between them. Lack of tools and policies, skepticism and complacency, and disparities between goals for peace and climate change are cited as the top reasons why these efforts do not overlap[79].

State-level resource cooperation is difficult to induce from a public health perspective, but there are many creative ways non-governmental organizations can increase environmental resilience while building bridges of communication between hostile parties. For example, many states receive most of their freshwater from rivers they share with other states. The Good Water Neighbors Project linked 28 Israeli, Palestinian, and Jordanian communities together with the shared interest of water resources, building new sewage systems, reducing water pollution, and improving agricultural practices. These initiatives follow the theory of "environmental peacebuilding," built on the premise that the purpose of peacebuilding is to move a population from vulnerability to self-sufficiency and well-being. Environmental cooperation should be considered one component of the solution to conflict as it contributes to resilience, sustainability, and dialogue across borders[80]. To build a sustainable and equitable peace, such cooperative programs must recognize power imbalances and other considerations of a specific water conflict outside of a solitary focus on technical capacity building between actors[81].

CONCLUSION

The term "collateral damage" is too often used as a euphemism when the lives of humans, usually the poorest and most vulnerable, are at stake. While a term of war, by all indicators we are set to start seeing a different kind of "collateral damage" over the coming decades: the health risks posed by accelerating climate change to the world's most vulnerable people. Without a significant turn of events, we will almost undoubtedly see increased food and water shortages, greater infectious disease outbreaks, and extreme weather events threaten more lives. It will be these fragile populations, already stretched to capacity due to living life in a place of destitution, political oppression, active violence, and mental degradation, that will be on the frontlines of these impending threats to health security.

When necessary, public health practitioners and advocates have come together to put forth policies that would reduce the injury and mortality outcomes of various health risks: smoking, car accidents, low vaccination rates, and reduced school-based physical education are just a few examples. Today in the United States, public health advocates are

even joining the fight for gun control, a highly politicized topic. It is necessary to do the same for the health risks presented by climate change. With the current political climate, meaningful global action on climate change seems unlikely. Implementing evidence-based practices that have demonstrated increased resilience while at the same time building on the existing knowledge base about climate change should be the focus of stakeholders who wish to change outcomes rather than endlessly debate political beliefs. While conflict and climate change are highly polarizing issues, not acting on preserving the dignity of human life should not be the default option.

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CLIMATE DISASTERS CONTAMINATE WOMEN: INVESTIGATING CROSS-NATIONAL LINKAGES BETWEEN DISASTERS, FOOD INSECURITY, AND WOMEN'S HIV IN LESS-DEVELOPED COUNTRIES

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HIV/AIDS remains a serious public health threat in less-developed countries, especially for women. Drawing on ecofeminist perspectives, we explore linkages between climate-related disasters, food insecurity, and HIV transmission. Using data from over 90 less-developed countries, we construct a structural equation model to analyze the direct and indirect influences on the percent of the adult population living with HIV who are women. We find that climate-related disasters are a significant factor shaping women's HIV vulnerability indirectly through increased food insecurity. Food insecurity is theorized to alter social relationships and behaviors, including risky sexual behaviors, forced sex, and transactional sexual relationships. Our results confirm that disasters lead to conditions of hunger and resource deprivation, which serve to escalate HIV transmission among vulnerable women in poor countries.

INTRODUCTION

Climate-related disasters in developing countries continue to increase in number and magnitude, as extreme weather events have more than doubled in the last 30 years.[1] Including the direct devastation resulting from hazards such as floods, storms, and droughts, extreme weather events are also one of the leading causes of global hunger. Disasters can increase food insecurity and malnutrition by destroying land, livestock, crops, and food supplies, and more than 80% of the world's hungry people live in disaster-prone countries.[2] Climate-related disasters displace 22 million people annually, and displaced people often lack adequate access to food.[3]

While the linkages between hunger and climate-related disasters are clear, related consequences of resource constraint, deprivation, and displacement may also have other health impacts, especially for women. The impact of climate-related disasters on gendered vulnerabilities to HIV remains underexplored in current literature, despite that the effects of climate-related disasters may influence social relationships and behaviors, including risky sexual behaviors. For example, in societies characterized by poverty and pronounced gender inequalities, hunger or food insecurity may lead women to engage in transactional or unsafe sex, increasing their exposure to HIV. Indeed, ecofeminist literatures emphasize women's connection to the environment as the providers and caretakers of the household, highlighting that under conditions of resource deprivation, women's well-being is often compromised.

Global trends in HIV reveal that women are disproportionately vulnerable to HIV in less-developed countries, largely due to gender inequalities.[4,5] Thus, the purpose of this paper is to examine the effects of climate-related disasters on women's disproportionate vulnerability to HIV in less developed countries. To do so, we build a theoretically driven model of the percent of the population living with HIV who are women as influenced by economic, social, political, and environmental factors. As current trends emphasize the

rising HIV burden among women in particular, we prefer to examine climate change effects on the proportional burden of HIV among women in comparison to men, to more appropriately consider how disasters shape gendered inequalities in HIV. This is a more appropriate strategy than using a prevalence rate, given that female HIV rates mirror total prevalence rates of HIV cross-nationally. As such, female prevalence rates are illustrative of the general level of HIV in a country, not necessarily the disparity in disease vulnerability between women and men.

It is important for research on HIV/AIDS to incorporate thorough examinations of the impacts of climate change and other environmental factors as women in less-developed countries suffer most from the effects of climate change and are also located in social positions that increase their likelihood of acquiring HIV in less-developed countries. We draw on ecofeminist theorizations to articulate the impacts of climate-related disasters on women's health, as elaborated below.

GENDER, HIV/AIDS, AND ECOFEMINISM

Globally, women now make up almost 60% of worldwide HIV/AIDS cases and this disease represents the primary cause of death for women of reproductive age.[6] The unequal distributions in HIV/AIDS across men and women characterizing less-developed countries is likely to intensify as females account for more than 80% of all new HIV infections among adolescents and young adults in developing countries.[7] While certain populations, such as men who have sex with men and individuals who inject drugs, remain at high risk of acquiring HIV/AIDS, the most common mode of HIV transmission in less-developed countries is through heterosexual sexual intercourse.

Thus, the factors leading to the enhanced likelihood of suffering from HIV among women in poor countries often center on gender-based inequalities that limit their socioeconomic status, access to health resources, and reproductive autonomy that would otherwise help prevent against infection.[8,9,10] The combination of gender-based inequalities, poverty, lack of education, and inadequate health resources poses acute threats to the well-being of women in the less developed world.[11,12] These factors are interconnected dimensions of strife that co-occur and exacerbate one another in ways that severely compromise the health of women in poor countries.

Ecofeminist theorizations are especially instructive in illustrating how environmental factors, including climate-related disasters, shape women's susceptibility to diseases such as HIV, as they posit patriarchy and capital accumulation are twin aspects of the current economic regime that yield adverse consequences for women and the environment, resulting in their shared domination and oppression.[13] Additionally, the traditional household duties and responsibilities accorded to women result in their heightened vulnerability to environmental changes and disasters. For example, women in poor countries are primarily responsible for subsistence farming and household food production. Indeed, women supply the bulk of food, water, and other basic necessities for family members; as climate-related weather events complicate women's ability to provide basic household resources, women themselves become increasingly vulnerable to disease.[14,15] For example, women must walk farther to find clean water when local sources are contaminated or compromised and they have to hoe longer or garden farther from the home when land is degraded or destroyed.

Thus, an ecofeminist perspective elucidates that women's deep connection to the environment is exemplified in less-developed countries through social and cultural gender norms, where women depend on environmental resources to meet ascribed gender expectations and to provide for their families' health and well-being. Although limited scholarship has discussed a connection between climate-related disasters and women's HIV, more empirical research is needed to establish such relationships. Disasters constrain food production and interrupt food supplies, and malnutrition and nutrient deficiencies can increase susceptibility to many infectious diseases, including HIV/AIDS.[16] However, the links between suffering from climate-related disasters and women's disproportionate vulnerability to HIV is not just physiological; social mechanisms also put women at undue risk for diseases like HIV in the wake of disasters.

CLIMATE-RELATED DISASTERS, HUNGER, AND SURVIVAL SEX

Natural hazards include events like storms, floods, and droughts, and socio-economic, political, and environmental factors create vulnerabilities that turn these episodes into disasters.[17] While all countries suffer from hazards, disasters in less-developed countries are excessively and acutely devastating due to conditions of poverty. Limited economic development, poor infrastructure and healthcare, and authoritarian regimes often explain heightened risks to and effects of disasters in poor areas.[18] A burgeoning area within the disasters research literature provides a meaningful focus on gender, offering that women in less-developed countries are disproportionately vulnerable to disaster-related adversities given their relegated status and dependence on the natural environment.[19]

Climate-related disasters present specific challenges to women's health. When food is scarce, women and girls often eat last, due to male preference in patriarchal societies. Furthermore, as treated above, disasters such as flooding, droughts, and other severe weather patterns complicate women's role as resource collectors and caregivers. Given the deleterious impacts of disasters on the availability or production of basic provisions such as food, women may succumb to engaging in transactional sex or risky sexual behaviors in order to gain access to needed resources.

Indeed, women in less-developed countries are often forced to engage in transactional sex to obtain food or other basic needs, commonly referred to as "sex for basic needs".[20] Transactional sex primarily occurs from men to women, and encompasses non-marital, non-commercial sexual relationships where money and gifts are exchanged.[21,22] Importantly, a wide body of research finds that risky sex practices, such as transactional sex and inconsistent condom use, are pronounced among women who encounter food insecurity.[23,24] In limited contexts, these conditions have been directly linked to HIV, such as the documented fish-for-sex trades in Sub-Saharan Africa, which are identified to perpetuate HIV transmission among women in coastal communities who have no other means of feeding themselves or their families due to environmental declines.[25] As food insecurity is often triggered by climate-related disasters that impinge on food production, the potential connections among disasters, hunger, and HIV among women are salient.

Transactional sex is not limited to populations in less-developed countries; however, we emphasize that transactional sex is especially common in poorer places where women face extreme socio-economic disadvantages. For example, one study conducted in Tanzania found that 75% of sexually active teenage girls received gifts or

money at their first experience of sexual intercourse.[26] As developing countries have the highest HIV prevalence rates, transactional sex poses a much greater risk of acquiring HIV in these countries for women.

Furthermore, women often engage in transactional relationships with older men who tend to be more economically stable and thus are able to provide payment or gifts. Older men tend to have much higher rates of HIV in developing countries than younger men, as they have had more sexual partners over the life course.[27] Thus, demographic patterns within many poor countries reveal that younger women and older men are the sub-sets of the population with the highest levels of HIV. Age and wealth gaps in relationships facilitate imbalances in power, leading to increased occurrences of sexual violence and limited condom use, which amplify risks to HIV for women. In transactional sex arrangements, condom use tends to be low overall,[28] thus representing a particular avenue for HIV transmission.

In general, a wide body of evidence links climate-related disasters to hunger, and scholarship also suggests important linkages between food insecurity and risky sexual behaviors among women in poorer countries. Collectively, prior research in this vein leads us to formulate specific hypotheses regarding the effect of climate related disasters on women's HIV burden in developing countries. We elaborate these, as well as on the methods and data used to test them below.

MAIN HYPOTHESIS

We predict that suffering from floods, storms, or droughts increases food insecurity in less-developed countries, which then leads to disproportionate levels of HIV among women in less-developed countries. In other words, we expect that suffering from floods, storms, or droughts has an important indirect influence on the percent of the population living with HIV who are women, specifically by elevating food insecurity.

SAMPLE

We utilize a sample of 91 less-developed countries. We restrict our sample to less-developed countries, commonly defined as those in the lower three quartiles of the World Bank's Income Classification of Countries, due to the specific relevance of gendered inequalities, disasters, and HIV/AIDS in poorer countries. Our sample consists of 91 less-developed countries for which complete data are available for the percent of HIV cases in the population among women. We include the list of countries included in the sample in Table 1.

Table 1: Countries Included in the Sample (N=91)

Afghanistan	Eswatini	Nepal
Algeria	Ethiopia	Niger
Angola	Gambia, The	Nigeria
Armenia	Georgia	Pakistan
Bangladesh	Ghana	Papua New Guinea
Belize	Guatemala	Paraguay
Benin	Guinea	Peru

Bhutan	Guinea-Bissau	Philippines
Bolivia	Guyana	Rwanda
Bosnia and Herzegovina	Haiti	Senegal
Botswana	Honduras	Serbia
Burkina Faso	Indonesia	Sierra Leone
Burundi	Jamaica	Somalia
Cabo Verde	Jordan	South Africa
Cambodia	Kenya	South Sudan
Cameroon	Kyrgyz Republic	Sri Lanka
Central African Republic	Lao PDR	Sudan
Chad	Lesotho	Syrian Arab Republic
Colombia	Liberia	Tajikistan
Comoros	Madagascar	Tanzania
Congo, Dem. Rep.	Malawi	Togo
Congo, Rep.	Malaysia	Tunisia
Costa Rica	Mali	Uganda
Cote d'Ivoire	Mauritania	Ukraine
Cuba	Mauritius	Uzbekistan
Djibouti	Moldova	Vietnam
Dominican Republic	Mongolia	Yemen, Rep.
Ecuador	Montenegro	Zambia
Egypt, Arab Rep.	Mozambique	Zimbabwe
El Salvador	Myanmar	
Eritrea	Namibia	

METHODS

To assess the potential direct and indirect influence of disasters, food insecurity, and other important measures on the percent of the population living with HIV who are women, we utilize structural equation modeling (SEM). SEMs are especially useful for this analysis as research discussed above suggests there may be complex pathways involving suffering from disasters, food insecurity, and women's burden of HIV/AIDS. The use of SEM allows us to easily calculate the indirect effects of disasters on women's percent of HIV cases, for example, while also taking into account other known predictors, such as contraceptive use. These indirect effects, while frequently theorized in prior research and policy reports, are frequently overlooked in studies that only use traditional regression-based methods.

SEM has additional advantages, including estimation using a maximum likelihood (ML) missing value routine that calculates pathway coefficients on the basis of all available data. This means that when data are missing for select variables, the cases are dropped from those pathway estimations but retained for others when data are available. Thus, SEM allows us to use as much information as possible from a larger sample of countries because cases are not lost if they are only missing information on one or two control variables.

In addition, SEMs are useful when the indicators of interest can represent underlying latent concepts. In this research, we hypothesize that female secondary

schooling, fertility rates, and the percentage of births attended by trained medical personnel are highly correlated and represent an underlying latent variable of, "women's socio-health standing." The SEM framework allows for the inclusion of latent variables and for the estimation of unbiased coefficients, even when the independent variables are highly correlated. Thus, complications due to multicollinearity are eliminated. SEMs also facilitate comparison of the theoretically derived, hypothesized model to the actual data, providing an estimate of model "fit" to the data provided. Based on these features, SEM represents an appropriate and useful analytic approach for this line of research.

It is important to ensure adherence to the key assumptions of SEM, including: multivariate normality, completely random missing data, sufficiently large sample, and correct model specification.[29] To address the potential issues of multivariate non-normality, we also estimated the models using the robust ML estimator (MLR) in Mplus, which are robust to non-normality.[30] The results were consistent with those achieved with the basic ML procedure. In meeting assumptions about missing data, we note that most statistical approaches in this field require that data be missing completely at random, while the use of the maximum likelihood (ML) estimator provides consistent estimates under the assumption of missing at random, which is a far easier condition to satisfy. Additionally, we find no pattern to the missing data to suggest that the data are not missing at random. As an additional robustness check, we also compared results to those obtained with a listwise-deleted sample and achieved consistent findings to those presented below.

Assumptions about sample size can be challenging to meet with cross-national data. Due to the relatively small sample size, we also conducted our analyses with bootstrap standard errors as well as a robust ML (MLR) procedure and obtained estimates and model fit statistics for the path diagram that were consistent with the ML estimator. In protecting against model specification errors, we carefully draw on prior research and theory in selecting our variables and constructing the models. Our review of the literature appropriately merges perspectives on gender, development, disasters, and health to inform model specification.

One potential limitation of our research is the cross-sectional design. However, reliable and expansive longitudinal data on key indicators, including women's HIV data, are not available over multiple time points in a consistent manner. To improve conditions of causality and to address the unique nature of HIV where there may be a time lag between contracting the disease and testing positive for it (especially among poor populations), the variables are time-ordered, where the independent variables are measured prior to the dependent variables. Specifically, the women's percent of HIV is measured for the year 2018, contraceptive use and food insecurity are measures for the year 2016, women's socio-health status variables are measures for 2015, disasters are measures from 2010-2016, as described below, and all other control measures are from 2010.

In addition to specific measures on suffering from climate-related disasters, food insecurity, and the percent of the population living with HIV who are women, we include other key indicators, as alluded to above, to ensure the pathways hypothesized are relevant net of the influence of other factors known to impact women's HIV in less-developed countries. Our choice of variables centers on factors of confirmed relevant in prior cross-national investigations of women's HIV.[31,32,33] For example, we include measures of women's socio-health standing to capture gender inequality dynamics in

social and health factors most salient to HIV, such as participation in education, fertility rates, and the percentage of births attended to account for women's access to healthcare. We also incorporate women's use of contraceptives given their potential to prevent against HIV transmission (e.g. condoms) directly, and because use of any contraceptive method signals greater reproductive autonomy for women.

We additionally include measures of GDP per capita and democracy to capture the influence of economic development and political freedoms. Our analyses also consider a measure of percent Muslim, as prior research demonstrates lower levels of women's HIV in Islamic countries, likely due to strict sexual norms against behaviors like prostitution and extramarital sex.[34] Lastly, it is also important to consider public health infrastructure; thus, we include a measure of the number of health workers. The formal definitions and sources for each indicator are outlined in the section below.

Given the focus on HIV/AIDS in the analysis, we also examined the influence of antiretroviral therapies (ARTs), which can improve the lifespan and well-being of HIV-positive individuals, and thus have a powerful influence on HIV prevalence rates. We did not find any significant influence of ARTs on the percent of people living with HIV who are women in our analyses. This result is likely due to the manner in which our outcome is measured, as a relative proportion of HIV/AIDS between women and men rather than a prevalence rate. The lack of significance for ARTs in the models suggests that such interventions are not impacting the distribution of disease between men and women.

In addition, we tested for the influence of several other measures, including urbanization, health expenditures, agriculture as a percent of GDP, food production, latitude, external debt, and population growth, among others. None of these were significant in predicting the percentage of population living with HIV who are women, or other key measures, such as food insecurity. Their inclusion did not disrupt the substantive findings reported here. We exclude these measures from the models presented here on the basis of parsimony.

VARIABLES INCLUDED IN THE ANALYSIS

Women's Percent of HIV: We employ the percent of the population living with HIV who are women as the dependent variable for this study. This measure, the percent of the population age 15+ living with HIV who are female, obtained from the World Bank,[35] is based on HIV estimates originally published by the Joint United Nations Programme on HIV/AIDS or UNAIDS. As current trends emphasize the rising HIV burden among women relative to men, especially within less-developed countries most at risk to climate-related disasters, we examine the proportion of HIV-infected individuals who are women to appropriately engage the gender stratification and ecofeminist themes treated above that emphasize disproportionate impacts of disasters on the health and wellbeing of women.

Percent Affected by Disaster: We examine harm caused by disasters by including the percent of the population affected, injured, left homeless, or killed due to a flood, storm, or drought. We focus on floods, storms (including hurricanes, tornados, severe storms, etc.), and droughts as they are among the most common and widespread climate-related disasters. Those "affected" by disasters include people requiring immediate assistance, such as those lacking basic survival needs for food, water, shelter, sanitation and medical assistance. These data come from the EM-DAT Database.[36] For a disaster to

be in the database, at least one of the following conditions must be met: ten or more people reported killed, one hundred or more people reported affected, the declaration of a state of emergency, or call for international assistance. To create the measure of percent of people suffering from a disaster, we summed the number of people affected, injured, left homeless, or killed for each nation in a given year due to floods, storms, and droughts, which was then transformed into a proportion of the population using corresponding total population data for the same year (obtained from the World Bank 2019). The proportions for each year were averaged for 2010-2016, to avoid idiosyncratic findings that might emerge from a single major event in a given year.

Prevalence of Moderate or Severe Food Insecurity: We measure food insecurity using data from the Food and Agriculture Organization[37] on the prevalence of moderate or severe food insecurity. This measure is an estimate of the percentage of people in the population who live in households classified as moderately or severely food insecure. The measure is calculated using data collected with the Food Insecurity Experience Scale or a compatible experience-based food security measurement questionnaire.

Health Workers: Controlling for access to health services is important in the analysis, as reliable public health infrastructure can prevent death, injury, or illness in a wake of a disaster. We include the number of health workers, which represents the number of trained doctors, nurses, and midwives per 100,000 people, and includes both generalist and specialist medical personnel.[38]

Democracy Index: We consider the role of democracy, as democratic countries tend to have better human health and well-being outcomes. The democracy measure is based on annual country-level averages of civil liberties and political rights from the Freedom House World Report.[39] These two components are operationalized on a seven-point ordinal scale where higher scores represent higher levels of civil liberties and political rights.

GDP per capita: We include GDP per capita as a measure of economic development. GDP per capita is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment, and government spending, divided by the mid-year population. It is converted into current international dollars using Purchasing Power Parity (PPP) rates, which provides a standard measure allowing for cross-country comparisons of real price levels.[40]

Percent Muslim: Using data from Pew Research Center's World Muslim Population by Region and Country,[41] we include the percentage of the national population who identify Islam as their religious affiliation.

Contraceptive Use: The contraceptive use rate is the percentage of women ages 15-49 who are practicing, or whose sexual partners are practicing, any form of contraception.[42] Use of contraceptives is important to consider as some methods directly protect against HIV transmission.

Female Secondary School Enrollments: To capture women's participation in secondary schooling, we utilize a gross enrollment ratio, which refers to the ratio of female educational enrollment regardless of age to the female population of the age group corresponding to secondary level education.[43]

Fertility Rate: We also control for the fertility rate, which is defined as the number of children a woman is expected to have if she lives to the end of her childbearing years.[44] Lower fertility rates among women signify increased empowerment and improved health.

Table 2: Correlation Matrix and Univariate Statistics

	1	2	3	4	5	6	7	8	9	10	11
1. Women's Percent of HIV	1										
2. Percent Suffer from Floods, Storms, Droughts	0.15	1									
3. Food Insecurity	0.78	0.34	1								
4. Health Workers	-0.59	-0.21	-0.47	1							
5. Contraceptive Use	-0.55	0.22	-0.35	0.51	1						
6. GDP per capita, PPP	-0.46	-0.11	-0.47	0.58	0.59	1					
7. Percent Muslim	0.01	-0.12	0.02	-0.09	-0.7	-0.21	1				
8. Democracy	-0.11	0	-0.14	0.05	0.29	0.35	-0.34	1			
9. Female Secondary School Enrollments	-0.67	-0.28	-0.78	0.47	0.71	0.58	-0.32	0.49	1		
10. Fertility Rate	0.67	0.15	0.73	-0.41	-0.68	-0.49	0.23	-0.3	-0.85	1	
11. Births Attended	-0.52	-0.12	-0.57	0.42	0.6	0.43	-0.2	0.29	0.74	-0.69	1
Mean	45.5	2.3	45	0.9	42.7	4918	31.5	3.8	64.2	3.5	79.6
Standard Deviation	16.7	3.1	23.1	1.3	21.4	3562	38.8	1.6	29	1.4	20.9

Births Attended: As a measure of women's specific access to healthcare resources, we include the percentage of births attended by skilled health professionals. Births attended by skilled health staff are the percent of deliveries attended by personnel trained to give the necessary supervision, care, and advice to women during pregnancy, labor, and the postpartum period, to conduct deliveries on their own, and to care for newborns.[45]

RESULTS

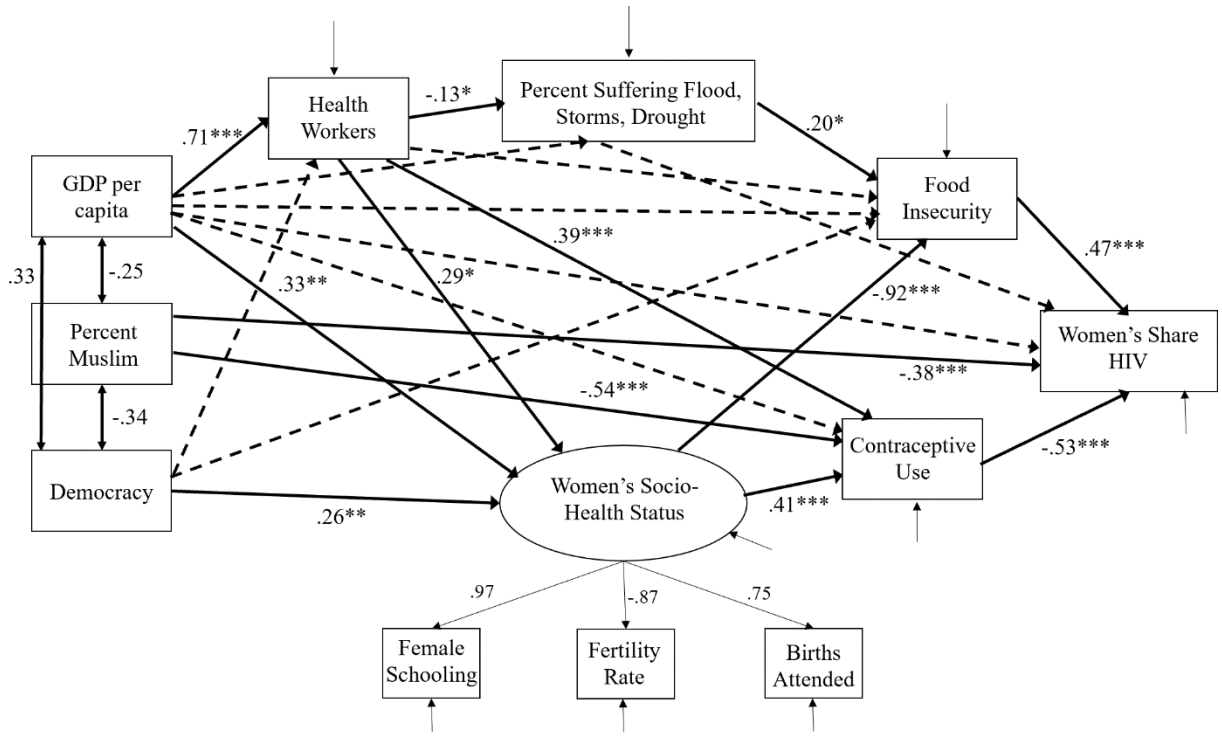
Table 2 displays the correlation matrix and univariate statistics for our sample of countries. The correlation matrix provides initial confirmation of important associations between food insecurity and women's percent of HIV, as well as disasters and food insecurity.

Table 3: Regression Estimates for SEM Equations Predicting the Percent of the Population Living with HIV who are Women

Regression Path	B	SE(B)	$\widehat{\beta}$
Women's Socio-Health Status → Female Secondary Schooling	.977***	.025	1.000
Women's Socio-Health Status → Births Attended	.761***	.055	.567
Women's Socio-Health Status → Fertility Rate	-.871***	.035	-.045
Democracy → Women's Socio-Health Status	.231*	.091	3.973
GDP per capita, PPP → Women's Socio-Health Status	.324**	.125	.002
Health Workers → Women's Socio-Health Status	.300*	.117	6.063
Women's Socio-Health Status → Contraceptive Use	.345***	.105	.302
Women's Socio-Health Status → Food Insecurity	-.773***	.060	-.630
Percent Muslim → Contraceptive Use	-.485***	.092	-.302
Health Workers → Contraceptive Use	.395***	.116	6.995
Contraceptive Use → Women's Percent of HIV	-.608***	.122	-.419
Percent Muslim → Women's Percent of HIV	-.397***	.115	-.171
Food Insecurity → Women's Percent of HIV	.486***	.090	.360
Percent Suffer from Flood, Storm, Drought → Food Insecurity	.212*	.084	1.516
Health Workers → Percent Suffer from Flood, Storm, Drought	-.203*	.109	-.468
GDP per capita, PPP → Health Workers	.670***	.074	.000
Notes: Standardized Coefficients flagged *** p < .001, ** p < .01, * p < .05 (two-tailed tests)			

The main results are presented across Tables 3-4 and Figures 1-2. Figure 1 presents a more saturated model of the percent of the population living with HIV who are women. We tested all theoretically and substantively informed paths. Statistically significant paths are denoted with a solid line and display the standardized regression coefficients. Pathways that were not statistically significant are indicated with a dashed line. We note that the fit statistics for this model are in an acceptable range, as explained below.

Figure 1: SEM Predicting the Percent of the Population Living with HIV who are Women, Saturated Model

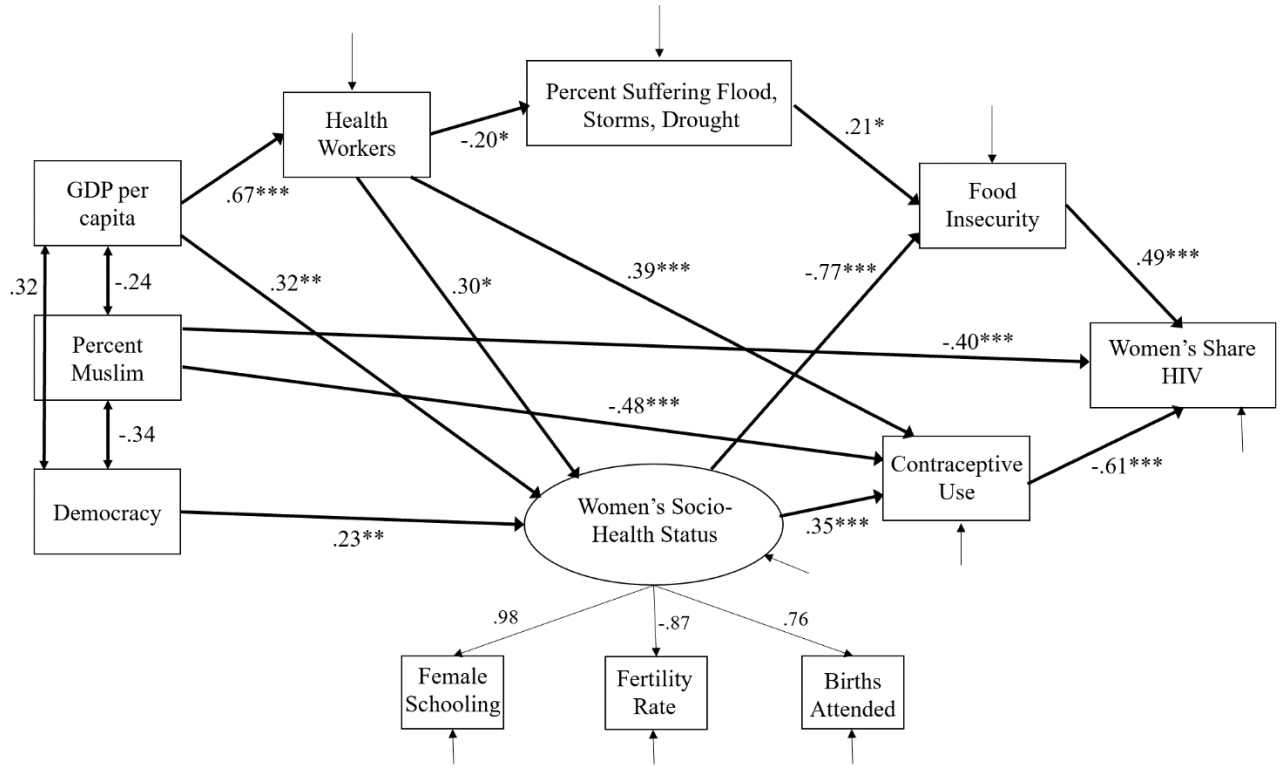


*Notes: Standardized coefficients reported: *** p < .001, ** p < .01, * p < .05, (two-tailed tests)*

While many pathways displayed in Figure 1 are statistically significant, including those connecting suffering from disasters, food insecurity, and the percent of the population living with HIV who are women, there are several non-significant associations conveyed as well. As is convention in this tradition, we present a parsimonious model in Figure 2 that eliminates non-significant pathways. We focus our interpretation of results on the model presented in Figure 2, but include Figure 1 to demonstrate that the statistically significant relationships discussed were maintained even when additional associations were included. In addition to the path diagram, we provide unstandardized regression coefficients, standardized regression coefficients, and standard error estimates in Table 3 for the model displayed in Figure 2 (results for the saturated model in Figure 1 are available upon request). These can be interpreted just as regular regression estimates, indicating the nature and magnitude of the relationship between the variables specified.

Before interpreting results of the SEM model presented in Figure 2, it is obligatory to examine the overall model fit statistics that evaluate the fit of our model to the data provided. In accordance with standards used in this empirical tradition, the chi-square test statistic is nonsignificant ($\chi 2 = 43.9$ with 36 degrees of freedom), the values of the Incremental Fit Index (.980), Tucker–Lewis Index (.961), and the Confirmatory Fit Index (.979) all exceed .90, and the root mean squared error of approximation (RMSEA) value is below the suggested threshold of .05.[46] Together, these fit measures demonstrate excellent model fit to the data and permit interpretation of the pathway coefficients, all of which are statistically significant at the .05 level or better.

Figure 2: SEM Predicting the Percent of the Population Living with HIV who are Women



*Notes: Standardized coefficients reported: *** p < .001, ** p < .01, * p < .05, (two-tailed tests)*

Concerning our central research question, the results presented demonstrate important causal pathways involving suffering from drought, food insecurity, and HIV, where less-developed countries with a larger proportion of people suffering from floods, storms, and droughts tend to have increased food insecurity (.21). Additionally, less-developed countries with elevated prevalence of food insecurity tend to have higher proportions of women living with HIV in comparison to men (.49).

In addition to the relevance of food insecurity, the results presented in Figure 2 and Table 3 demonstrate that contraceptive use is associated with declines in the percent of the population living with HIV who are women (-.61) in less-developed countries. Percent Muslim is another important factor explaining cross-national variation in women's burden of HIV; less-developed countries with larger Muslim populations tend to have lower proportions of HIV among women relative to men (-.40), and also lower levels of contraceptive use (-.48). Women's socio-health status, a latent measure represented by female secondary school enrollments, predicts contraceptive use (.35) and food insecurity (-.77), where less-developed countries with improved socio-health status of women tend to have higher average rates of contraceptive use and greater prevalence of moderate or severe food insecurity.

Health workers are important for a number of indicators in the model, including suffering from disasters. Less-developed countries with more trained health workers tend to have lower prevalence of suffering from floods, storms, and droughts (-.20). Countries with increased numbers of trained health workers are also more likely to have improved women's socio-health status (.30) and contraceptive use (.39). We also find that less-

developed countries with higher GDP per capita, or increased levels of economic development are more likely to have trained health workers (.67) and improved women's socio-health status (women's schooling, low fertility rates, births attended) (.32). We also find that democracy is associated with improved women's status (.23) in less-developed countries.

In comparing results across Figures 1 and 2, it is important to note that we found no relationship between GDP per capita, or level of economic development, and suffering from disasters, food insecurity, contraceptive use, or women's share of HIV. This suggests that economic gains in less-developed countries only reduce disaster vulnerability and women's susceptibility to HIV insofar as they are channeled to appropriate resources, such as health workers or women's access to schooling and reproductive healthcare. Importantly, we tested for a direct relationship between disasters and women's share of HIV, as shown in Figure 1, but no statistically significant relationship surfaced; thus, food insecurity represents the primary mechanism linking suffering from disaster to women's HIV vulnerability in less-developed countries.

Indeed, the effects of many relevant predictors on women's percent of HIV, such as suffering from disasters, are indirect. Thus, further scrutiny is needed to assess if the overall impact of a given measure on the percent of the population living with HIV who are women is significant. The findings for the complete indirect, direct, and total effects for each indicator are displayed in Table 4.

Assessing the statistical significance of the coefficients presented in Table 4, we verify that suffering from disasters is an important indirect factor associated with increasing the relative percent of women living with HIV in less-developed countries. Although the total effect of suffering from floods, storms, or droughts is smaller than others in the model, it remains a noteworthy influence increasing women's vulnerability to HIV in poorer countries. All other indirect indicators in the model were also found to influence women's share of HIV in less-developed countries, with the exception of percent Muslim. Given the negative direct impacts on women's share of HIV, alongside the positive indirect impacts through reduced contraceptive use, the total effect of percent Muslim is washed out, meaning there is no overall significant impact on the percent of the population living with HIV who are women in less-developed countries.

Table 4: Direct, Indirect, and Total Effects of the Predictors of the Percent of the Population Living with HIV who are Women

Predictor	**Women's Percent of HIV**		
	Direct	**Indirect**	**Total**
Contraceptive Use	-.608***	-	-.608***
	(.122)	-	(.122)
	[-.419]	-	[-.419]
Women's Socio-Health Status	-	-0.586***	-0.586***
	-	(.068)	(.068)
	-	[-.354]	[-.354]
Percent Muslim	-.397***	0.295**	-0.102

	(.115)	(.093)	(.070)
	[-.171]	[.127]	[-.044]
Democracy	-	-.135*	-.135*
	-	(.056)	(.056)
	-	[-1.405]	[-1.405]
GDP per capita, PPP	-	-.483***	-.483***
	-	(.067)	(.067)
	-	[-.002]	[-.002]
Health Workers	-	-0.437***	-0.437***
	-	(.090)	(.090)
	-	[-5.334]	[-5.334]
Percent Suffer from Flood, Storm, Drought	-	0.103*	0.103*
	-	(.043)	(.043)
	-	[.546]	[.546]
Food Insecurity	0.486***	-	0.486***
	(.090)	-	(.090)
	[0.360]	-	[0.360]

*Notes: Standardized coefficients flagged *** p < .001, ** p < .01, * p < .05, (two-tailed tests); Standard errors in parentheses; Unstandardized coefficients in brackets.*

On the whole, the results demonstrate that suffering from floods, storms, or droughts increases the percent of the population living with HIV who are women by elevating food insecurity. The results thus illustrate the role of climate-related disasters in contributing to disproportionately higher rates of HIV among women in comparison to men. Critically, we find significant total effects of women's socio-health status, health workers, GDP per capita, and democracy on women's HIV burden, often channeled indirectly through food insecurity and contraceptive use. Thus, environmental and socio-economic conditions are influential factors shaping women's unequal risk to HIV in poor countries.

CONCLUSIONS

The main conclusions imparted by the analyses center on the adverse effects of climate-related disasters on women's HIV burden. Specifically, we find climate-related disasters that worsen food insecurity in less-developed countries are a strong predictor of women's disproportionate vulnerability to HIV. While prior studies have demonstrated linkages between hunger and risky sex practices that heighten HIV transmission, this is the first analysis of which we are aware to extrapolate such mechanisms using cross-national data across a large sample of less-developed countries. Moreover, our focus on women's vulnerability imparts additional information on the connections across gender, social,

and environmental inequalities that condition health outcomes including HIV. Given the scientific consensus on the likelihood of climate change to spur more frequent and severe disasters, it is especially important for research in this vein to carefully integrate dimensions of gendered inequalities into future discussions of disasters and health.

In addition to our primary focus, we provide further confirmation for the influence of other economic, social, and political factors on women's HIV burden. Economic development strengthens women's socio-health status and the availability of health workers, both of which lead to higher rates of contraceptive use that decrease the percent of the population living with HIV who are women. Democracy represents an important factor shaping women's HIV burden due to its positive effect on women's socio-health status that lessens their gendered vulnerability to HIV. We find percent Muslim to have conflicting direct and indirect effects on women's HIV burden, where percent Muslim directly decreases women's percent of HIV, but indirectly increases it through its depressing effect on contraceptive use, leading to an overall non-significant total effect. Importantly, we find that many of the salient factors, such as GDP per capita and democracy, only had indirect impacts on women's percent of HIV, as well as indirect impacts on suffering from disasters and food insecurity. Indeed, the results presented in the path diagram demonstrate that health workers and women's socio-health status represent important predictors of suffering from climate-related disasters and food insecurity, respectively, suggesting that advances in economic development and political freedoms matter only insofar as these gains are translated into public benefits, such as increased health infrastructure and opportunities for autonomy for women.

Our analysis, like all others, is subject to certain limitations. The international data accessible to researchers is limited, and greater refinement and availability of some measures would be beneficial, such as a measure of hunger among women or measures of transactional sex. Should those data become available, we advocate for further analytic scrutiny of the relationships identified here. In light of a lack of data on such refined measures, we captured the themes explored in prior research to the best of our ability with the cross-national data that is available. While an inability to capture some specific mechanisms, such as transactional sex, is a limitation, the trade-off is the ability to illustrate and validate such dynamics on a cross-national scale.

Additionally, endogeneity is a concern in any analysis. We endeavor to limit potential bias by carefully constructing theoretically-grounded models that include a host of economic, political, and social factors identified to be important explanations of women's health outcomes, in addition to the climate-related disasters that are our chief focus. While not exhaustive in including the universe of potential influences, we hope our findings lay a foundation for future work in the area.

In order to analyze the confluence of political, economic, social, and environmental factors on women's HIV burden, we employ SEM techniques to accommodate the direct and indirect linkages derived from our theoretically driven hypotheses. As climate change worsens and the complexities grow stronger, it is imperative that we adopt versatile analytic approaches to appropriately capture and reflect these contours. To be sure, the drivers of environmental and social phenomena are complex, interactive, and dynamic; these characteristics make SEM an especially favorable method for modeling such intricate systems. Future research should be dedicated to examining the complex and indirect relationships involving gender, health, and climate-related disasters.

Notably, in the current context of global climate change, the dynamics treated here will continue to be of the utmost importance. Long-term climatic changes (e.g., shorter growing seasons, higher mean temperatures) as well as erratic weather events (e.g., more frequent and severe floods and droughts) are likely to have increasingly adverse effects on food security and the health and well-being of women over time. As we have shown, suffering from floods, storms, and droughts are especially harmful to women's health and disease vulnerability and thus should be taken as a foremost concern for climate justice and gender equality advocates.

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CHOLERA, CONFLICT, CLIMATE VARIABILITY AND IMPLICATIONS ON THE YEMEN PUBLIC HEALTH SYSTEM

Destini M. Garrison, Radina P. Soebiyanto, Sarah Hutchinson, Assaf Anyamba and Tomoko Y. Steen

The Republic of Yemen has concurrently fallen victim to political and climatic disruptions causing the largest cholera epidemic. Recent conditions in Yemen provide a perfect paradigm of how conflict and climate magnify public health system insecurities, generating infectious disease outbreaks, like Vibrio cholerae. Population resistance to such infections depends on cooked foods, clean-water, and a proficient health infrastructure. This paper highlights the relationship between epidemic cholera, Yemeni civil war and climate fluctuations. Using publicly available data for cholera activity, migration, and rainfall variability we examine Yemen's crisis. The research findings implicate conflict induced migration and the Civil war interfered with public health infrastructure; and extreme rainfall attributed to cholera amplification. Reflecting on the health catastrophe, authors promote diplomacy to mitigate health infrastructure degradation in Yemen.

INTRODUCTION

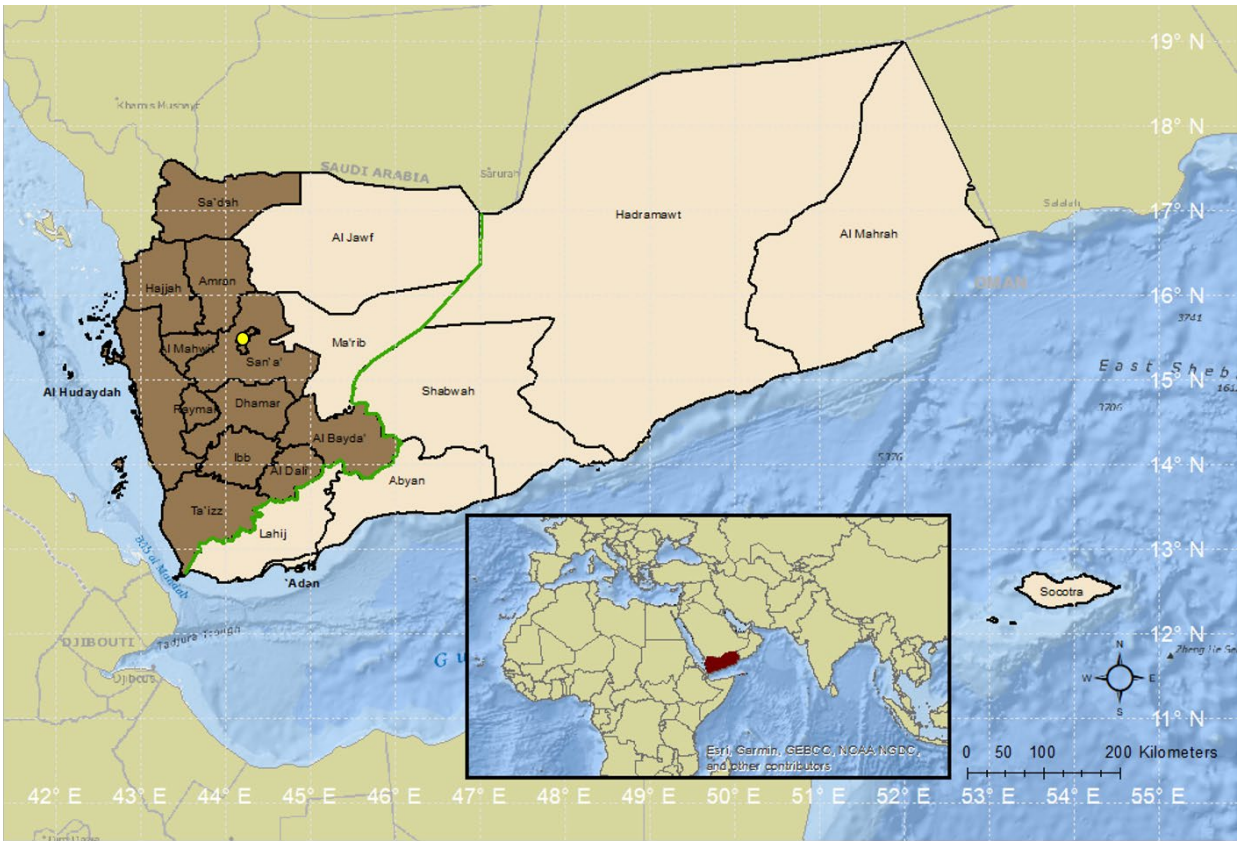
The Republic of Yemen

Yemen has endured ongoing political unrest since the unification of North and South Yemen in 1990. An ongoing civil war since 2016 has contributed to Yemen's failing public health system, which has caused a humanitarian crisis. This led to the most catastrophic cholera outbreak in the country's recorded history. The Shiite-Houthi rebellion and proxy war between Iran and Saudi-Arabia are imposing unsuitable conditions to restore functional public health infrastructure and improve access to basic human necessities. Unprecedented cyclonic weather events in 2015 and 2018 have also been a contributing factor to the destabilization and degradation of public health infrastructure. A failed government, conflict, and hazardous rain events provided the ideal environment for a persistent cholera outbreak. Health security's reliance on an operative national public health system, especially during periods of extreme rainfall, is supported by data gathered from ProMED Mail[1], WHO Eastern Mediterranean Regional Office (WHO EMRO)[2,3], United Nations High Commissioner for Refugees[4], United Nations International Organization for Migration[5], Internal Displacement Monitoring Centre[6], and National Oceanic Atmospheric Administration (NOAA) [7, 8].

Located in the Arabian Peninsula, the Republic of Yemen is historically a country of continuous tension.[9] Before the origin of Yemen, the land was divided, with the Ottoman Empire controlling the northern governorates (Yemen Arab Republic) and the British controlling the south (People's Democratic Republic of Yemen). It wasn't until 1918 that north Yemen gained independence, followed by southern Yemen in 1967.[9] Competition between north and south Yemen persisted until the emergence of the Republic of Yemen in 1990.[9] After unifying, the country remained vulnerable to conflict by insurgencies of Al-Qaeda, ISIS and the Shiite-Houthi Rebellion.

As shown in figure 1, the Shiite-Houthi insurgency began in the northern governorate, Sadah, invoking a war with the Yemeni national government in 2004.[10] The oppositionist group, allegedly supported by Iran, desires political reform that encourages governorate autonomy, a national political system independent of western intervention that is deeply rooted in Arab Nationalism, and pan Islamism that is intolerant to terrorist insurgencies.[11] After years of countrywide Yemeni protests for electoral reform, former-President Saleh resigned from leadership and President Abdrabbh Mansour Hadi took office in 2011.[10] During political turmoil, the Houthi rebellion spread across southwestern Yemen and compromised Yemeni military personnel to expand their following. Shiite-Houthis' demands for national administrative rights forced President Hadi to resign as President and allowed the rebellion to take over the capital city of Sana'a (administrative district of Amanat Al Asimah), led to the current Yemeni civil war.[10] President Hadi has joined the Saudi-led coalition to recover power in Yemen.

Figure 1. Study Area Map of the Republic of Yemen



Political Interventions

Saudi-Arabia and Iran have a power struggle to obtain regional hegemony, influence and preference. Yemen is among their most notable proxy war locations.[12]

Specifically, Shiite-Iran is accused of supporting and supplying weaponry to the Shiite-Houthi rebellion.[13] Supporting the insurgency assumes Shiite-Houthis' allegiance and gratification to Shiite-Iran. As Saudi-Arabia is currently the Arabian regional dominant power, Iran's involvement in the Yemeni civil war has prompted Saudi Arabia to lead a coalition to stop the advancement of Shiite-Houthis. The alliance is comprised of the Republic of Yemen's official government, the United Arab Emirates, Bahrain, Kuwait, Qatar, Egypt, Jordan, Morocco, Senegal, Sudan, the United Kingdom and the United States. The United Nations Security Council Resolution (UNSCR) 2216 grants neighboring countries authority to inspect cargo transits entering the country for weaponry items intended to supply, sale or transfer (UNSC 2015).[14] In compliance, Saudi-Arabia intercepted shipments of weapons, and as a consequence formed a blockade at Yemeni seaports.[15,16] Since Yemen imports 90% of all food and daily goods, the blockade induced famine and further degraded public health.[17,18]

Yemen's Climate and Cholerae Vibrio

The diarrheal illness is onset by enterotoxin-producing strains of bacteria *Vibrio Cholerae, commonly known as Cholera*, yet only serogroup O1 and O139 have factors of epidemic potential that warrant a public health emergency.[i,19] The bacteria propagate in wet and warm environments. Previously unexposed populations are most vulnerable in an epidemic, but where cholera is endemic most adult populations have natural immunity acquired by illness or asymptomatic infections.[19] A surveillance system capable of collecting, analyzing and disseminating data is essential for predicting epidemiological potential to prepare health infrastructure for an outbreak.[20] Resolving cholera requires hospitals to have diagnostic capacity, intravenous fluids or oral rehydration solutions.[21] Cholera outbreaks are widely attributed to contaminated water used for drinking, harvesting seafood, cleaning fruits and vegetables and in Yemen peak in the wet summer months.[i] Epidemics in Yemen Located in the northeastern hemisphere Yemen is mostly subtropical dry, with humidity along the coastal lines and desert in the east.[22] The country experiences harsh rainfall from April– August and November– July.[22] Reported in 2012, the average annual rainfall in Yemen was 508mm/20", with western governorates receiving the most precipitation.[22] With inadequate Water Sanitation and Hygiene (WaSH) capacities and vulnerability to rare dangerous tropical cyclones, flooding events and droughts, the country is not well equipped to combat cholera outbreaks.[23] Beyond water accumulated from spontaneous rainfall events, Yemen does not have a lasting body of water.[22] The country is defenseless to cholera, because it is water-stressed and lacks financial means to improve access to clean- water.[24]

[i] According to the Centers for Disease Control and Preventions (CDC), "within the O1 and O139 serogroups, the ability to produce cholera toxin (CT) is a major determinant of virulence." Isolates of V. cholerae O1 or O139 that produce CT are considered fully virulent and have much potential to cause cholera epidemics. According to CDC, in fact, the most V. cholerae isolated during cholera outbreaks would be toxigenic serogroup O1 or O139. CT is an enterotoxin causing uncontrollable excretion of fluid and electrolytes into the bowel that generates watery diarrhea, loss of fluid circulation and thus loss of blood volume, metabolic acidosis, potassium depletion, and can cause vascular collapse and death. However, not all serogroup O1 isolates produce CT, whereas non-toxigenic isolates also exist. Depending on the dose of CT, infection of O1 and O139 serogroups can present as asymptomatic– having mild diarrhea.[19]

METHODS

Cholera Outbreak Data

Cholera activity data in Yemen was derived from ProMED Mail[1] and WHO EMRO[2] online databases. We retrieved cholera outbreak reports from 2015–2019 in Yemen from ProMED Mail.[1] For each report collected, we georeferenced the outbreak location to the closest named governorate and recorded the number of cases (confirmed and suspected), starting date (if available), end date and deaths. WHO EMRO compiles cholera case data into a publicly available datasheet.[2] We assimilated WHO EMRO cholera data into the data collection format used for ProMED. To prevent the analysis of duplicate cases from ProMED and WHO EMRO, we filtered the data to only represent unique entries. The assembled data is reflective of cumulative cholera activity. We calculated the cholera incident rate per 1,000 people in each governorate and displayed the spatial distribution of cholera across the country using ArcMap.

We also collected data from WHO's Global Health Observatory Data Repository (WHO GHODR) from 1971–2011, which supports the historical record of cholera in Yemen.[3] Additionally, the historical data was used to analyze the ability of the Yemeni Ministry of Public Health and Population to control cholera outbreaks during various climatic and political circumstances.

Rainfall Data

Rainfall data was obtained from the daily African Rainfall Climatology (ARC) dataset from the NOAA- Climate Prediction Center (CPC) archives.[7,8] The dataset is available over Africa and the Arabian Peninsula at 0.1° x 0.1° spatial resolution from 1983 to present. The ARC datasets are produced using a combination of rainfall gauge measurements and satellites to produce the gridded rainfall estimates. [7,8] To derive governorate composite rainfall, we extracted pixels that fell inside the administrative boundary for at least 10% of its area. We subsequently took the average of these pixels to represent the rainfall in the particular governorate. The daily data was retrieved, and the monthly and annual yearly accumulation was calculated per governorate. Rainfall anomalies for each governorate was calculated by first calculating the long-term mean between 1983 to 2018 and subtracted this long-term mean from the current month's value. ArcMap was used to display the accumulative yearly rainfall and rainfall anomaly for each governorate.

Conflict Data

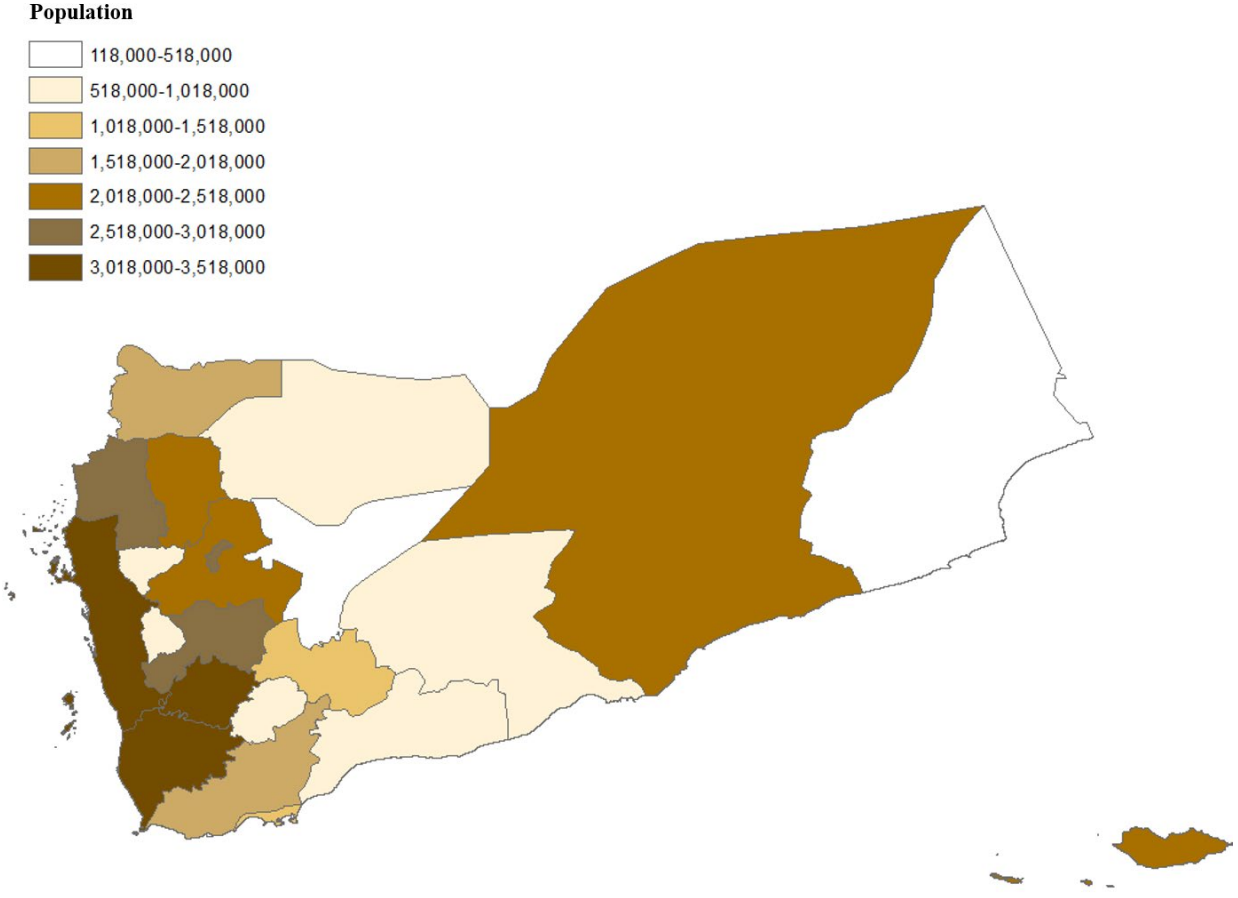
As conflict is poorly documented and vulnerable to bias, only airstrike data was collected from Relief Web Reports and the Armed Conflict Location and Event Data Project (ACLED) from 2015–2019.[25,26] Acknowledging acts of violence in the country are spontaneous and dynamic, only accumulated airstrikes were codified by date and governorate. Using ArcMap, airstrikes were geocoded to illustrate the most affected locations.

Population and Migration Data

Governorate population data was derived from the 2014 Republic of Yemen Ministry of Public Health and Population Annual Health and Statistical Report.[27] Migration data from 2014–2019 was compiled using the UN High Commissioner for Refugees[4], UN International Organization for Migration[5], and the Internal Displacement Monitoring Centre[6] to understand the country's internally displaced persons (IDPs) crisis. As it is common for IDPs to be displaced multiple times from different areas, only the initial displacement location, date, and cause of vacating were codified. Using ArcMap, the distribution of IDPs was illustrated to reveal the most burdened governorates.

RESULTS

Figure 2. Population per Yemeni governorate based on 2014 enumeration

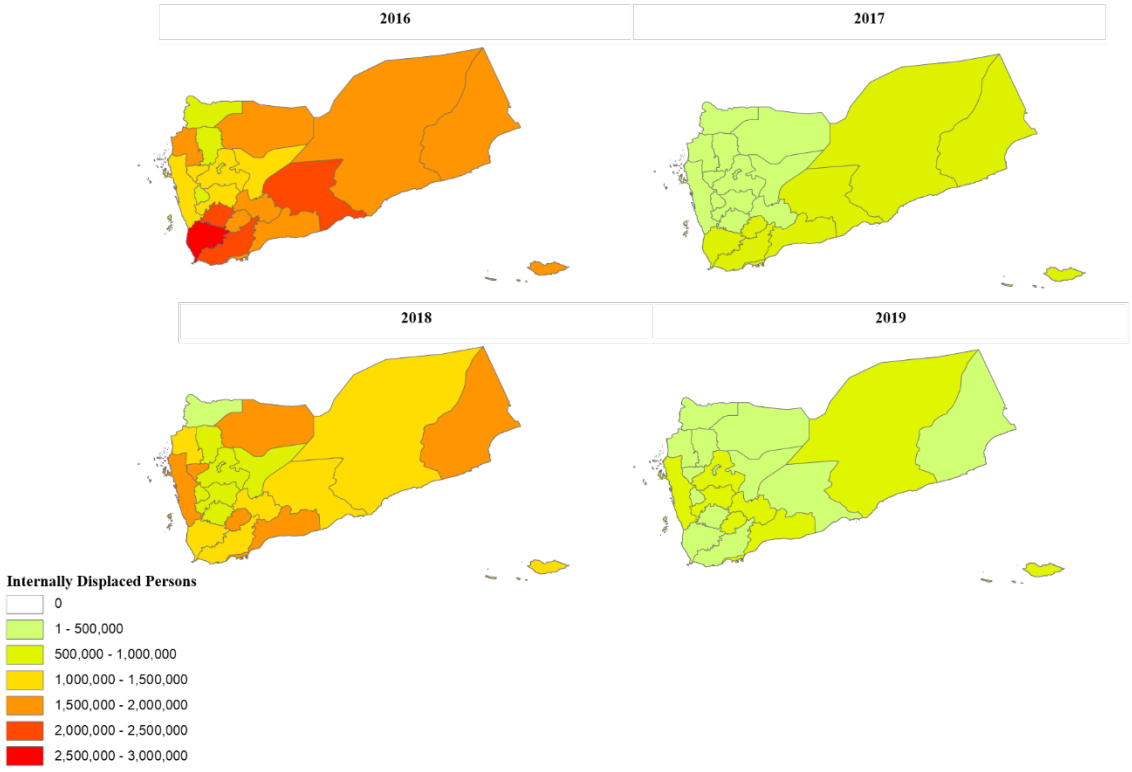


Data Source: The Republic of Yemen Ministry of Public Health and Population[27]

The total population of Yemen in 2014 was 25,956,000. Western Yemen has the most densely populated governorates— Amanat Al Asimah, Al Hudaydah and Tai'zz, as shown in Figure 2. The Shiite-Houthi rebellion originated in the northwestern governorate, Sadah, and progressed south.[10] Figure 3 shows the movement of IDPs follow a similar pattern. Governorates with more IDPs are in the south, suggesting Yemenis fled from the

rebellion. Prior to the Shiite-Houthi rebellion in 2014, there were fewer IDPs countrywide that distributed towards southwestern and central Yemen. As conflict heightened, IDPs amplified from 30,000 to 7,000,000, from 2014 to 2015. IDPs reduced to 3,000,000 at the beginning of 2016. Governorates Hadramawt, Al Mahrah, Tai'zz, Lahij, Ibb, Shabwah received an extreme population influx, which suggests IDPs fled away from Shiite-Houthi territory (Figure 3). Despite it being fewer IDPs in 2017, the migratory trend continued with a profound division of IDPs east of the Shiite-Houthi territorial boundary (Figure 1). IDPs augmented along the extremities of the country in 2018, while still eluding Shiite-Houthi territory. In 2019, IDPs have reduced to less than 1,000,000, and are located within rebellion boundaries, but are still evading northern Yemen. Although the number of IDPs have reduced since 2016, it remains higher than before the civil war began.

Figure 3. Internally Displaced Persons distribution across Yemen (2016-2019)

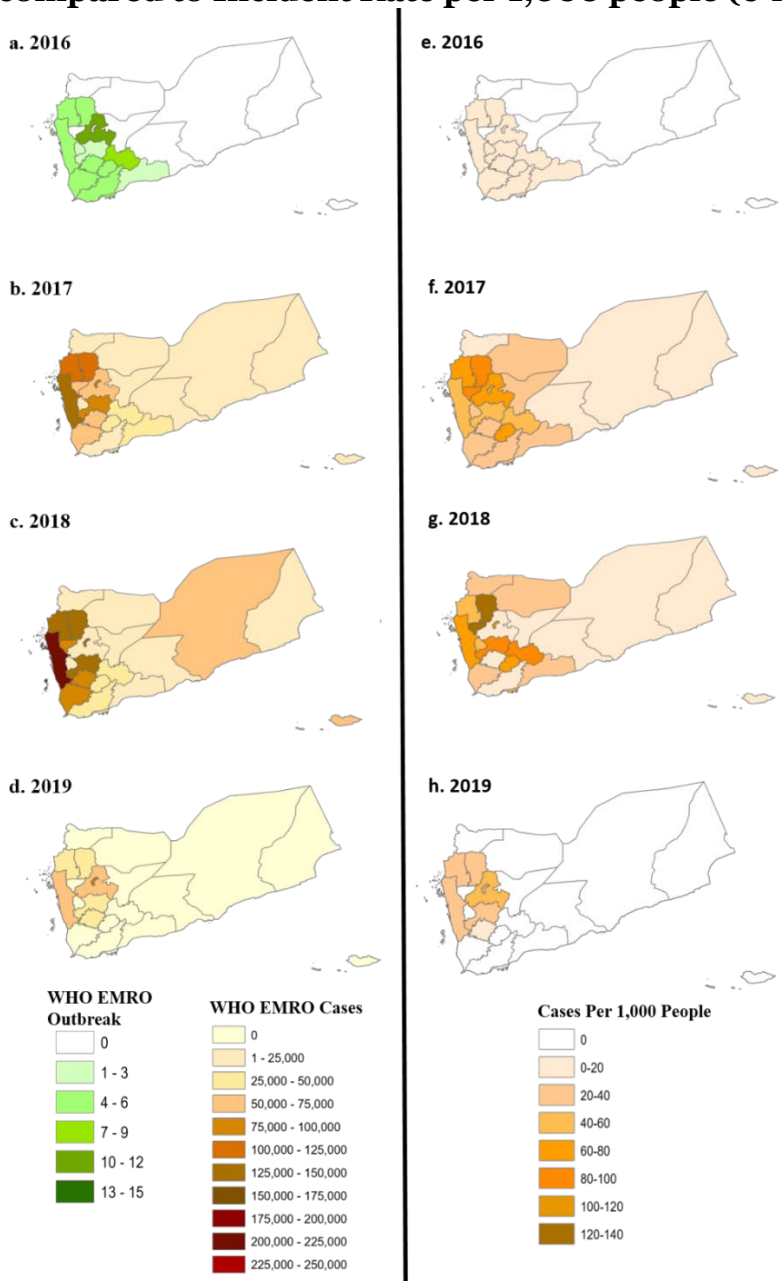


Data Source(s): United Nations Refugee Agency 2019[4], International Organization for Migration 2019[5], Internal Displacement and Monitoring Center 2019[6]

As shown in figure 4, the cholera outbreak began in 2016, yet the epidemic was not officially declared until April 2017.[24] Prior to the declaration of an epidemic, only outbreak incidents were recorded in 2016, as opposed to cases (Figure 4a). It is unclear how many cases there were in 2016 within the reported outbreaks; however, Sana'a recorded the most incidents (Figure 4a). In 2017, reporting advanced to case-based as the diarrheal disease spread across the country vigorously. All Governorates were ravaged with cholera, yet the most affected were located in the domain of the Shiite-Houthi

rebellion (Figure 4b). The most affected governorates were Al Hudaydah and Amanat Al Asimah—reporting between 125,000–150,000 cases and having an incidence rate of 40-60 cases per 1,000 people (Figure 4f). Even though Al Hudaydah and Amanat Al Asimah governorates reported more cholera cases, Amran and Al Mahwit governorates had inflated incident rates of 80–100 cases per 1,000 people (Figure 4f). Western governorates, excluding Sadah, incident rates were more than 20–40 cases. The eastern governorates incident rates did not exceed 20 cases per 1,000 people (Figure 4f).

Figure 4. 2016-2019 WHO EMRO cholera activity per governorate (a-d) compared to Incident Rate per 1,000 people (e-h)

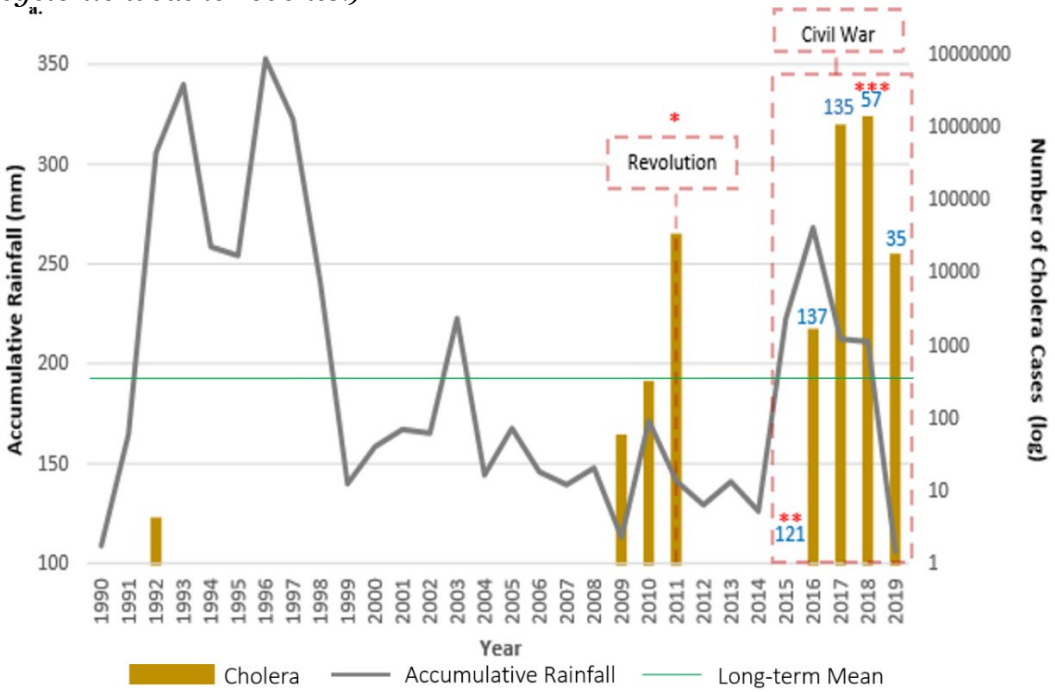


Data Source(s): World Health Organization Eastern Mediterranean Regional Office[2], The Republic of Yemen Ministry of Public Health and Population 2014[27]

Cholera cases peaked in 2018, with Al Hudaydah governorate consistently having the most reported cases, 200,000–225,000, uncomplimentary incident rates (Figure 4c). Although having fewer cholera cases than Al Hudaydah, governorates Amran and Al Mahwit had incident rates of 120–140 cases per 1,000 people (Figure 4g). Governorates Dhamar and Al Bayda had incident rates between 80–100 cases per 1,000 people. In the eastern governorates, Hadramawt reported the most cases, between 50,000–75,000 (Figure 4g). Yet, attributed to Hadramawt's' large population, the incident rate remained within the range of less affected surrounding governorates. The highest incident rates were located in the western region of the country. Currently, in 2019, reports of cholera are situated in the Shiite-Houthi rebellion territory (Figure 4d). The most reported cases are in governorate Amanat Al Asimah, 125,000–150,000, and an incident rate of 20–40 per 1,000 people (Figure 4d, 4h). More people are affected by cholera in Sana'a, as the incident rate is 40–60 cases per 1,000 people (Figure 4h).

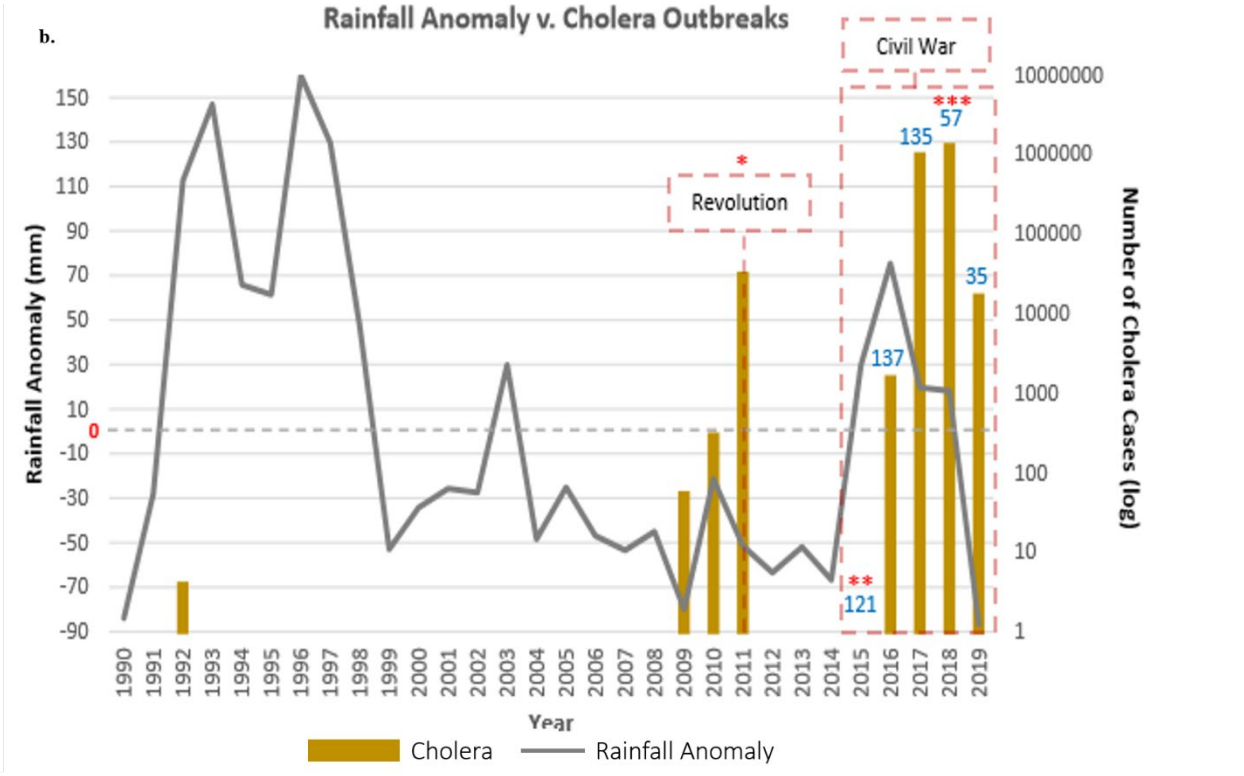
Rainfall in Yemen is noticeably higher at the onset of conflict beginning in 2015 as show in figure 5a, exceeding the average by 96.53mm. In 2016, rainfall continued to increase where it peaked at 268.24mm (75.464mm above average). Although accumulative rainfall values decreased in 2017 and 2018, the values remained above average at 212.5mm and 211.1mm, respectively. As seen in figure 5b, from 2015– 2017 rainfall amounts were consistently anomalously high. Yemen experienced cyclones (*) in 2008[28], 2011[29], 2015[30,31], and 2018[32,33, 34]; however, in 2008 and 2011 above average rainfall was not exhibited but the country experienced infrastructure destruction (Figure 5b). In 2018, despite above average rainfall, levels declined.

Figure 5a. Accumulated Rainfall vs. Cholera Outbreaks (Long-Term Mean 192.776 mm) *(Airstrikes are represented by blue numbers. Red asterisk (*) identify cyclonic weather events.)*



Data Source(s): A Seasonal Rainfall Performance Probability Tool for Famine Early Warning Systems[8], A 20-year daily Africa precipitation Climatology using satellite and gauge data Conference on Applied Climatology[7], World Health Organization Global Health Observatory Data Repository[3]

Figure 5b. Rainfall Anomaly vs. Cholera Outbreak *(Airstrikes are represented by blue numbers. Red asterisk (*) identify cyclonic weather events.)*



Data Source(s): A Seasonal Rainfall Performance Probability Tool for Famine Early Warning Systems[8], A 20-year daily Africa precipitation Climatology using satellite and gauge data Conference on Applied Climatology[7], World Health Organization Global Health Observatory Data Repository[3]

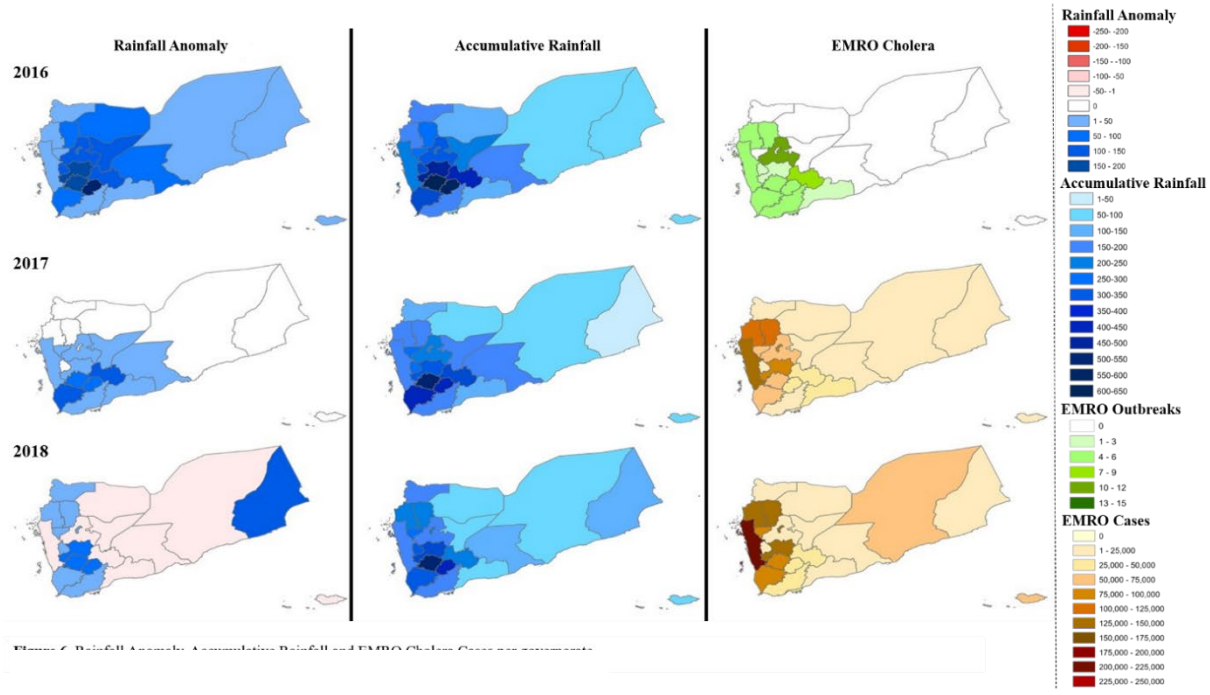
Anomalously high rainfall often contributes to an increase in cholera outbreaks.[24] We observed such a pattern in Yemen from 2016 onward (Figure 5a, 5b).[24] Yemen's endemic cholera coupled with a cyclonic event in late 2008 led to 55 reported cholera cases in 2009, which escalated to 300 in 2010 (Figure 5a, 5b). However, in 2011 cholera continued to advance, reaching 31,789 reported cases. Rainfall amounts for 2011 were below average and did not suggests suitable conditions for a rise in endemic cholera. In 2015, rainfall was anomalously high (29.875mm above average) but there were no reports of cholera activity (Figure 5a, 5b). External attention to conditions in Yemen in 2016 led to cholera reporting, which was concurrent with the peak in rainfall. As rainfall remained above average from 2016–2018, cholera activity followed respectively having 15,751, 10, 0006,920, and 1,309,915 cases. There is a difference in rainfall patterns when comparing the 2009–2011 cholera outbreak and the current epidemic (2016–2019); whereas, the first outbreak did not occur with high rainfall anomalies (Figure 5b).

Conflict was compared alongside rainfall and cholera to understand additional implications on the execution of the Yemeni Public Health and Population Ministry. The Houthi-insurgency began in 2004 but cholera incident data does not appear until 2009 (55 cases). Cholera cases expanded in 2010 to 300 cases simultaneous to the influx in rainfall (171.33mm). The Yemeni Revolution began in 2011, and cholera cases escalated to 31,789 cases, yet a decline in rainfall was observed. Progressing to 2015 at the onset of

the Yemeni civil war having 121 airstrike attacks and above average rainfall, there were no reports of cholera (Figure 5a, 5b). In 2016, Yemen received 137 airstrikes and there were 15,751 cholera cases recorded in the WHO GHODR. Epidemic cholera was declared in 2017, having 10,006,920 cases while suffering 135 airstrikes. In 2018, Yemen had 1,309,915 reported cholera cases, but sustained fewer airstrikes (57). Currently in 2019, there have been 35 airstrikes and 16,827 reported cholera cases.

Since the onset of the Yemeni Civil War, 2016 was the most saturated year with western governorates receiving the most rainfall. Furthermore, the most reported outbreaks were also in western governorates, as shown in figure 6. In 2017 and 2018 the wettest areas remained in the western region, yet rainfall decreased significantly in Al Mahrah, Hadramawt, Al Jawf, Sa'dah, Amant Al Asimah, Raymah, Amran and Hajjah. Governorates Ta'izz, Ibb, Al Dali' and Al Bayda sustained rainfall magnitudes similar to 2016 but reported fewer cholera cases (Figure 6). Conversely, Amant Al Asimah and Al Hudaydah governorates experienced an inverse relationship between cholera and rainfall. Cholera increasingly spread in dryer governorates, Amran and Hajjah, which reported 100,000-125,000 cholera cases. In 2018, rainfall quantity in governorate Hadramawt remained constant while cholera cases emerged. Additionally, while rainfall was at its highest, comparing 2016 to 2018, in Al Mahrah governorate cholera reporting remained low. Cholera persisted in all governorates experiencing heavy rainfall, except Sana'a.

Figure 6. Rainfall Anomaly, Accumulative Rainfall and WHO EMRO Cholera Cases per Governorate (2016-2018)



Data Source(s): A Seasonal Rainfall Performance Probability Tool for Famine Early Warning Systems[8], A 20-year daily Africa precipitation Climatology using satellite and gauge data Conference on Applied Climatology[7], World Health Organization Eastern Mediterranean Regional Office[2]

Figure 7 shows although Shiite-Houthi forces are the source of opposition, airstrikes were not centralized within rebel boundaries. In 2016, airstrikes excluded only governorates Al Mahrah, Al Dali', Amran, Hajjah, Al Hudaydah, Raymah and Al Mahwit making it the year with the most IDPs (Figure 7). Hadramawt governorate had the most attacks, followed by Amanat Al Asimah, Shabwah and Al Bayda'. The eastern governorates had more IDPs and airstrike attacks. In 2017 IDPs decreased nationwide, specifically reducing to less than 500,000 in Shiite-Houthi territory. Furthermore, in eastern governorates IDPs decreased to 1,000,000 (Figure 7). Airstrikes hit central governorates, making Ibb and Al Dali' the only rebel-controlled localities to be affected. Airstrike patterns in 2018 remained similar to 2017; however, IDPs continued to populate in eastern Yemen. Currently, airstrikes reduced to 11-20 in all affected governorates, except Al Bayda' who has endured 31-40 strikes thus far. The dispersion of IDPs in Yemen does not show a consistent pattern.

DISCUSSION

We have analyzed the extreme social and environmental circumstances in Yemen to understand the attendant effects on public health systems. Western Yemen is most dynamic, because it has Shiite-Houthi territory, dense population, national ministries (located in Amanat Al Asimah), and port cities– Al Hudaydah and 'Adan. Considering the context concerning political intervention, locality of governing ministries, ports and the greatest population is imperative when assessing the interconnection of the data in support of a cholera epidemic.

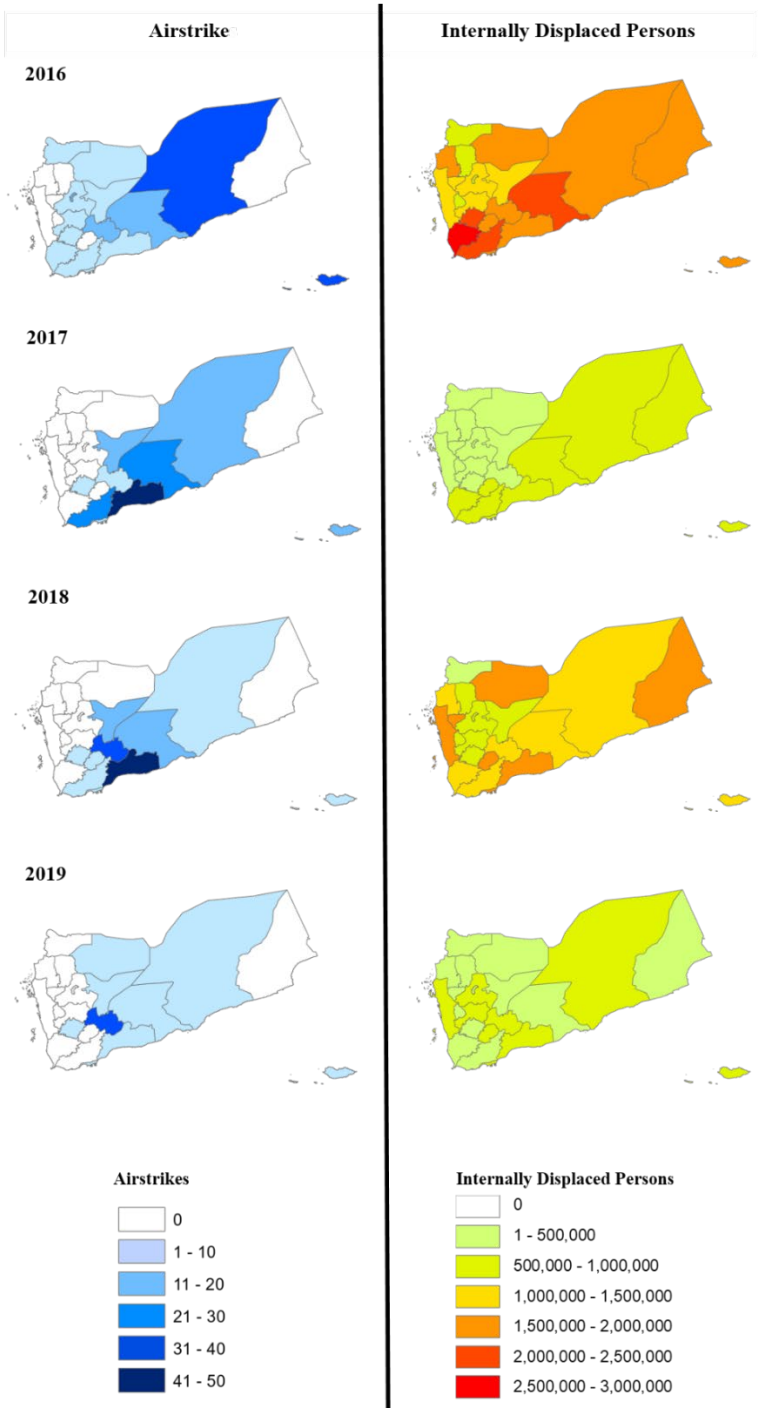
To limit biases and subjectivity of violence, and conflict in this study was restricted to airstrike events. Ground conflict was not included in the analysis, because each encounter is unique and challenging to quantify. It is essential to acknowledge that all violence throughout the Shiite-Houthi territory was not assessed in this research. Airstrikes and ground fighting have reportedly been occurring indiscriminate to public health infrastructure, government buildings, clean water tanks, homes, schools and markets. Such events discourage productivity and promotes discordance and migration.

Referring to data collected before the civil war reveals the cause of the epidemic. This case study explicitly includes IDPs who migrated to other localities to evade conflict. The analysis portrays conflict as a cause of migration, from 30,000 IDPs in 2014 to 7,000,000 in 2015, as tensions heightened. As people migrate from the conflict, they carry undiagnosed cholera to areas that are not aware of the outbreak and lack the capacity to detect, prevent and control. Also, public health systems are designed to treat patients within the immediate community, which limits its' capabilities and resources. Clean-water is also a limited resource to migrants, because of the finite quantity caused by the blockades and conflict.

Cholera is endemic to Yemen, which reinforces the Ministry of Public Health and Population capability to control outbreaks. Rain and cholera have a positive relationship; whereas, cholera is amplified during high rainfall periods. Yemen has low annual rainfall, which suggests endemic cholera is promoted by other stimulants, like inadequate WaSH procedures. The 2009–2011 cholera outbreak in Yemen had below average rainfall, which insinuates there is an additional factor that supports epidemic cholera. However, in 2015 rainfall was above average and accompanied by a cholera outbreak in 2016. An apparent connection between cholera and rainfall is not observed countrywide, aside from western

governorate elevated cholera cases and anomalously high rainfall levels. Densely populated governorates accompanied by anomalously high rainfall and deteriorating resources allows for undetectable cholera to escalate.

Figure 7. Airstrikes by Governorate compared to location of internally displaced persons (2016-2019)



Data Source(s): ACLED Data[26], ReliefWeb[25]

The association between cholera and conflict was emphasized when analyzing pass cholera outbreaks in Yemen. Reports from 1990-2014 indicate cholera is an endemic disease that the Yemeni Ministry of Public Health and Population can manage during stable political conditions. Adversity involving Shiite-Houthi forces heightened in 2008, which coincides with the 2009 cholera outbreak. The cholera outbreak escalated through 2011 during the Yemeni Revolution. Apart from cyclones in 2008 and 2011, rainfall was below average, suggesting conflict is more likely to be a determining factor of large cholera outbreaks during this period of time. Following the Yemeni Revolution, ending in February 2012, cholera outbreaks returned to unreportable significance until 2015. It is assumed the civil war interrupted health reporting systems; whereas cholera wasn't reported until 2016. The crippled public health system delayed assistance from the international community. Early reports were of outbreak activity, rather than case-based. Although ProMED case reporting and WHO tracking began in 2017, it remained challenging to interpret the spread of the outbreak. There is a connection between cholera and conflict in Yemen; whereas, the 2011 outbreak occurred simultaneous to the Yemeni revolution, just as the current epidemic began at the onset of the civil war. As a byproduct of war, the blockade supported by UNSCR 2216 also bestowed public health consequences. Yemen was deprived of essentials for human life and basic necessities for proficient public health and WaSH practices.

National governance is the foundation for public health and WaSH systems. Studies have suggested that proper WaSH practices are the first defense mechanism against cholera.[23] Described by the World Bank, Yemen is the poorest country in the Middle East and North Africa region.[35] The Republic has sustained many political unrests, which has resulted in unequipped and inoperative WaSH systems during adverse conditions– leading to diarrheal disease epidemics. The case study of Yemen is capricious and complex as conflict, climatic fluctuation, and migration cohesively promoted the cholera epidemic.[21] Poor governance coupled with indiscriminate hostilities and limited access to clean-water can cause endemic cholera to become epidemic.

CONCLUSION

Public health crises in failed states are challenging to analyze because of multiple interconnected variables. International infectious disease reporting systems, like ProMED and WHO, lack access to information during war which inhibits disease tracking. Reporting systems that track conflict and IDPs may have a political bias that distort analysis, if not assessed diligently. As climatic fluctuation is spontaneous, it is extensively strenuous to analyze the implications in a failing state.

As conflict impacted Yemen's public health capability, climate fluctuation also exposed vulnerabilities in the country's public health capacity. Cholera is a waterborne disease that flourishes in untreated water. The absence of a clean-water supply combined with elevated rainfall levels worsened WaSH practices in Yemen. The conflict placed a monopoly on water sources, which further deprived access to clean-water. Without an optimum sanitation system, *Vibrio cholera* accumulated to form the worse outbreak in Yemen's reported history. The 2011 Revolution and simultaneous cholera outbreak set a precedent for inadequacies in Yemen's public health infrastructure during conflict. Debris ravaged Yemen coupled with rainfall and limited access to clean-water generated the ideal environment for a cholera epidemic. The analysis of migration, conflict, and rainfall to

identify the cause of epidemic cholera in Yemen, supports that national governance is essential in maintaining optimum public health.

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CLIMATE CHANGE, INTERNATIONAL MIGRATION, AND HEALTH SECURITY: THE NEED FOR SMART AND SYNERGISTIC GLOBAL HEALTH POLICIES AND PROGRAMMES IN THE SOLOMON ISLANDS

Sebastian Kevany

The Solomon Islands, as with many resource poor settings, faces multiple direct and indirect threats to public health. These include environmental, population, health security and globalization considerations; similarly, a range of ostensibly non-health issues such as the development of squatter camps in urban centres such as Honiara, inter-island migration, and climate change all require resources and attention from the public health perspective. In the context of tuberculosis and malaria, we consider the range of levels on which such health and non-health issues interact from the health security perspective, and how the use of smart global health and global health diplomacy paradigms may help to resolve these problems in a synergistic manner.

INTRODUCTION

The health security needs of developing nations differ substantially from those of the developed world. In this regard, differing definitions of health security for developing and developed countries have ben proposed, with the former defined as and the joint containment of domestic and international epidemic threats.[1] Further, the unique geography of island nations contains a range of health security vulnerabilities not present in other contexts. Though in some cases maritime borders may enhance health security efforts, in other cases the concentrated populations and isolation with which such countries are often associated creates a new health security risk for each one that is eliminated.

The ongoing presence of tuberculosis and the high burden of malaria in Solomon Islands are both connected with such health security concerns. For tuberculosis (with a rate of 84 cases per 100,000 population[2]), the risk of transmission and outbreaks has been heightened by demographic and migration issues, including the related ongoing threat of the identification of the cases of multi-drug resistant tuberculosis.[3] For malaria (with 86,000 cases recorded in 2016), the dramatically increased caseload of recent years[4] is connected to both improved surveillance systems revealing new cases (particularly in rural areas) but also may be linked to issues such as climate chance and migration.

We attempt here to adapt the health security threats associated with (1) geography, (2) governance, and (3) other global stressors to explain the needs and responses of developing island nations such as the Solomon Islands. More specifically, and based on extensive exposure and site visits to remote outer island health clinics throughout the country on behalf of the Global Fund to Fight AIDS, Tuberculosis and Malaria, we consider the country's health security issues associated with maritime borders and inaccessible regions (geography), the role of non-health actors in health security responses (governance), and migration patterns and climate change (global stressors).

The broad scope of causes of potential health security threats to Solomon Islands that are described here are then collectively reviewed through a health diplomacy and smart global health focus in order to better inform health efforts that advance both health security, delivery, care, access and international relations simultaneously, in keeping with the smart global health approach to the design and delivery of multifarious programs that operate on both health and non-health levels.[5] In turn, we consider how local and international global health security actors, as well as instruments and forums such as the International Health Regulations[6] (designed to harmonize aspects of health security policies internationally) and the Global Health Security Agenda[7] (designed to achieve greater consensus in health security approaches and policies internationally), might also in future help to address island-specific issues and threats.

REGIONAL VULNERABILITY TO HEALTH SECURITY VIA CLIMATE CHANGE

The Solomon Islands are representative of a region of the world that is highly susceptible to climate change, with particular reference to rising sea levels.[8] The archipelago is also located in close proximity to an area of ozone depletion,[9] and has already experienced consequences of climate change in its agricultural sector.[10]

As a result of these effects, links between climate change and health security have been suggested. Among these include changes in migration patterns, as communities from countries such as Kiribati are relocated and naturalized in to rural areas of neighbouring countries such as the Solomon Islands. With such population movements come inevitable health security risks -- in this case, heightened levels of tuberculosis in such communities. Within the Solomon Islands population, there has also been a dramatic increase in squatter camps on Guadalcanal in recent decades,[11] a development that has been implicitly linked with changing resource extraction patterns and international commodity process, which may in turn also be (directly or indirectly) traced back to climate change effects.

Health security is also affected by climate change considerations via changing patterns of disease vectors such as mosquitoes, which may be contributing to the dramatic increase in detected malaria cases in the Solomon Islands in recent years.[12] Beyond migration patterns and disease vectors, climate change is implicitly linked with health security in the Solomon Islands in the context of its geographical location. The country's closest neighbour, Papua New Guinea, faces numerous health security challenges including the rise of multi-drug resistant strains of tuberculosis.[13] While the Solomon Islands remains MDR-TB-free, there is a risk that these and other conditions will threaten to overwhelm the public health system in the country unless appropriate investments are made.

Health security is therefore implicitly and intimately connected with climate change in the South Pacific, particularly for low-income countries susceptible to migration, global economic commodity fluctuations, and rising sea levels. Without appropriate attention to these concerns, health security in the region will continue to deteriorate. Conversely, those countries that are most active in assisting the health security preparedness of partner nations such as the Solomon Islands (e.g. the United States and Australia) may also benefit from improved regional cooperation, non-health security, and stability in the 'enlightened self-interest' context.

SOLOMON ISLANDS' POROUS MARITIME BORDERS

Health security is just as much a pressing issue in archipelago island nations such as the Solomon Islands as it is in the Western democracies.[14] Just as Europe and the United States have developed both military and civilian capacity in order to prepare for transnational epidemics, so too are such smaller countries increasingly aware of the need to develop local measures to combat international disease transmission threats via associated national emergency response plans.[15]

To date, despite a significant tuberculosis caseload, the country has remained free of drug-resistant forms of the disease. Its close (and much larger) neighbour Papua New Guinea, by contrast, has recorded multiple cases as geographically close as 50 miles from the Westernmost of the Solomon Islands.[16] The border between, for example, Bougainville and Choiseul Island is notoriously porous, with only a one hour motorboat crossing required and limited local capacity for immigrant control. Similarly, from the malaria perspective, advances towards malaria elimination on low-prevalence islands such as Choiseul will be threatened by low health security.[17]

A HEALTH SECURITY POLICY WITHOUT AN ARMED FORCE

To further compound the Solomon Islands' latent health security challenges such as proximity to the disease risks of Papua New Guinea[18] and porous maritime borders,[19] the island nation operates -- almost uniquely in the modern world -- without a standing army or air force.[20] Instead, responsibility for military or civil emergencies is delegated to the National Guard and civil defence, with assistance from Australian armed forces, the combination of which was last called in to action in 1999 during the Guadalcanal civil conflict.[21] As a result, health security measures cannot be delegated, in emergency cases, to the military in the way that the United States and Europe deployed to Sierra Leone, Liberia, and Guinea in order to attempt to enforce vector control during the 2014 Ebola outbreak.[22]

Although the Solomon Islands maintains a small naval force, the absence of such capacity may be considered as a threat to health security. Although most developed and developing countries manage health security issues without resort to armed forces, in many other settings beyond those referenced above, an enhanced role for armed forces in responding to epidemic or outbreak issues, though imperfect,[23] has been an essential element of disease control.[24] This has the dual benign knock on effects of diverting military energy away from conflict while also channelling defence funding in to humanitarianism.[25] Rather than invest in defence for this purpose, however, the challenges of maintain health security without armed forces may require a more holistic strategy involving the engagement of a much broader range of civil, national and international stakeholders including the newly-strengthened and Australian-supported Royal Solomon Islands Police Force.

INACCESSIBLE REGIONS

The health security challenges of the Solomon Islands are further compounded by the inevitable difficulties associated with regional and provincial governance in a country consisting of over 900 islands. In the Gizo province, for example, areas controlled by religious sects under such leaders as Silas Eto'o are still considered to be off limits to most forms of public or national intervention -- including planned visits from the Prime Minister.[26] The refusal of such semi-autonomous areas to accept any form of public health provision on their domains means that there may be

further health security risks of undetected tuberculosis, malaria and even HIV/AIDS in such areas.

GLOBALIZATION, MIGRATION AND POPULATION

Straddling both the health and non-health spheres, the development of large squatter camps in the Solomon Islands' capital city of Honiara, as well as in other provincial urban centres, is the culmination of broader elements of economic and social change. With the closure of mining and other industries which attracted migrant workers from other islands, such townships have grown exponentially in recent years.[27] Simultaneously, government attempts to resettle non-native islanders to their original homes have often met with failure, as the home societies no longer recognize the local community legitimacy of the migrant workers.[28]

The growth of such townships has also been closely linked to increases in both tuberculosis and malaria detection and transmission due to cramped living spaces, creating a domestic (if not international) health security and epidemic risk. Social policies to address such conditions (e.g., improved primary care and sanitation investments) may therefore be given added impetus, from both domestic and international funders, through the deployment of related health security arguments for funding and support.[29] From the international migration, urban health and health security perspectives, the strategic design of health care programs that also ensure that greater and greater populations are not concentrated in smaller and smaller areas is an essential element of the country's long term public health planning. Yet the development and implementation of such strategies, including the strengthening of regional and provincial health services to generate incentives for rural repopulation, will requires extensive coordination and interdigitation between departments of health, environment, and the interior.[30]

CLIMATE CHANGE REVISITED

A further argument for the development of coordinated, interdigitated systems of health and non-health responses in the Solomon Islands is presented in the context of climate change. It is increasingly evident that the Solomon Islands are amongst those countries most affected by the joint threats of ozone depletion and rising sea levels.[31] As a result, there is an increasing need in such settings to factor both (1) the health and health security risks of climate change (e.g. the risk of greater communicable disease transmission for both malaria and tuberculosis vectors) and (2) associated public awareness and responsiveness in to health care, public health, and associated resource allocation decisions.

In regards the latter, the World Health Organization (WHO) has begun efforts to improve primary health care functionality for climate resilience, including efforts to both (1) facilitate community participation and action and (2) support ministries of health in enhancing associated interdepartmental planning and managerial capacity.[32] In turn, at the policy level, this supports the case for increased interaction between departments of health and climate change, as well as cross-referencing between associated policy documents, as has been initiated by the Solomon Islands' Department of Health.[33]

A further key risk of climate change in the malaria and tuberculosis health security context relates to the concentration of population groups in ever smaller island communities.[34] The increase in community proximity and associated

limitations to living space, as the nearby island chain of Kiribati has compellingly demonstrated, may create ideal conditions for tuberculosis epidemics to flourish.[35]

Such connections between climate change and health are further driven by the effects of the relocation of Kiribatian and other island populations to Choiseul, Malatia, and other islands by the Solomon Islands government, including the provision of local citizenship.[36] Such policies, while laudable on an international relations level, may increase the risk of infectious disease outbreaks, as has been demonstrated by the higher associated disease incidence and prevalence levels in such communities.[37] Nonetheless, a balance between health security responses to globalization, migration and climate change should be tempered by the flip side of increased risk of racial stigma, often bordering on xenophobia, that may result from associations between nationality, ethnicity, and disease.[38]

A final related concern connecting both climate change and international migration is the ongoing high level of logging and mining in the Solomon Islands, with its potential joint environmental, climate, and disease transmission effects on the country. High levels of migrant workers -- attracted not just by security from climate change, but also by the job opportunities offered by local and international corporations -- necessarily heightens the risk of disease transmission and outbreaks is amongst such communities, despite the high quality of private corporate health care that is often provided.[39] Notwithstanding such health security threats, there remains the circular risk of increased logging and mining activities, in themselves, hastening the process of climate change and therefore related public health concerns.[40]

THE CASE FOR SMART APPROACHES

Through the identification of the above links between realms and considerations as diverse as urban overpopulation, climate change, globalization, migration, the strength of the armed forces, and health and non-health security the Solomon Islands also makes a case for significantly strengthened public health support from donors. As it is demonstrated with greater and greater certainty that 'smart' global health investments (i.e. those that are designed and delivered with both health and non-health goals in mind such as combining tuberculosis prevention with climate change responses) can have effects on these and other diverse issues such as national integration, peace keeping, and economic and political stability[41] (just as investments in the latter may also improve health), so too is the case for international health system support such as that provided by organizations such as the Global Fund to Fight AIDS, Tuberculosis and Malaria made more compelling. Similarly, the benefits and value non-health investments and contributions to security and environmental issues may benefit from a more holistic assessment of program design impact, including on disease control and transmission, as demonstrated by the sector-wide President's Recovery Plan for Ebola in Sierra Leone.[42]

In this regard, for the Solomon Islands to continue its upward pattern of development, the creation of a functioning health system is an essential component. However, given the manifold challenges articulated above that the country faces, a cross-cutting health response is required that also -- where possible -- addresses both health and non-health issues in a synergistic way. As noted above, the development of selected rural health centres, for example, may help to reverse the trends of rural depopulation and therefore urban township TB transmission. Yet the development of such centres would also, in border areas such as Taro in the Choiseul Province, act as key health surveillance and security facilities to monitor the health of international

migrants. Similarly, it is only through health care program and system design that recognizes and prepares for the effects of climate change that associated prospective health risks will be mitigated.

BALANCING HEALTH SECURITY WITH HEALTH DIPLOMACY

Countries such as Great Britain and Australia have indicated that they plan to invest significantly greater amounts in global health in countries such as Solomon Islands in order to counteract the increasingly competitive strategic interests of countries such as China in the region.[43] Health and health security prerogatives may also help related actors such as the United Kingdom's Department for International Development and the Australian Department of Foreign Affairs to generate the bilateral political will required to ensure adequate levels of global health funding (and therefore improved health security) for such partner developing countries. However, this will require significant re-evaluation of donor priorities in way that balances needs of (for example) health system strengthening against health security.[44] Although Australia's 2017 Foreign Policy White Paper[45] does not address such issues in detail, its prioritization of health security in the Indo-Pacific region is indicative of such as awareness as well as its basis in an enlightened self-interest approach.

In addition, while from both the bilateral and multilateral perspectives it can be synergistic to blur lines between health security and global health funding (while also leveraging overlaps with globalization and climate change responses), in the development of smart health security responses it is critically important to avoid contamination of health security goals by xenophobic, isolationist, or anti-immigration agendas.[46] The development of health security policies in countries such as Solomon Islands therefore should be tempered by health diplomacy approaches in program and intervention design[47] in order that health gains (e.g. through armed forces deployed internationally or on national borders on the basis of epidemic or transmission control) are not made at the expense of broader diplomatic or international relations losses.

Of note, nether the International Health Regulations[48] [49] or the Global Health Security Agenda[50] make explicit reference to the use of global health diplomacy tools and approaches in the design and implementation of global health security efforts.[51] As a result, such key international policy instruments may need to be adapted for relevance to the island nation context based on these and related findings. While such innovative and essential instruments are highly attuned to the needs of both continental and developed countries, their adaptation in future iterations (e.g. in the composition of action packages related to real-time surveillance or biosecurity) to the specific capacity and needs of small and often isolated developing countries may be of significant value.

CONCLUSION: HOW THE USE OF SMART GLOBAL HEALTH PARADIGMS CAN HELP TO RESOLVE HEALTH SECURITY PROBLEMS

As we have tried to demonstrate here, island nations face unique challenges for which donor support or other resources will be needed to establish and maintain an integrated, comprehensive health security enterprise that is responsive to multiple potential threats. Such support will also invariably benefit developed country donors as island nations are prevented from becoming overlooked incubators for possible future epidemics. In turn, the use of smart or diplomatic approaches to health

security considerations in countries such as Solomon Islands may facilitate the effective implementation of health security policies. With awareness of both the domestic and international consequences of such policies on both health and non-health levels (including in terms of international relations and possible malign *quid pro quos* that would stifle trade and diplomacy), successful related initiatives are more likely to be refined and sensitized to non-health concerns. More specifically, the use of smart global health approaches to malaria and tuberculosis interventions stands to integrate security, accessibility and international relations concerns in to program design and delivery in a coherent and harmonized way.

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BEYOND THE 'ASEAN-WAY'?
THIRD-SECTOR DRIVEN GOVERNANCE ALONG SARS AND HAZE POLLUTION

Thomas Lange

What role can regions, or more precisely regional organizations, play in the further development of international health and climate policy? If one shifts the view from the global system to regional spaces, it becomes clear that the development of International Health and Climate Governance is strongly influenced by regional activities. However, regional organizations often represent entities with tensions why the question arises to what extent regions can promote or even hamper international health or environmental policy. One example is ASEAN whose slow regional integration is shaped by the "ASEAN Way". This low degree of legalization is accompanied by an ongoing socialization of regional governance: Civil society actors such as Non-Governmental Organizations (NGOs) play an increasingly important role in combating community problems, that politics actively promotes their involvement. This also applies to challenges affecting health and the environment in ASEAN, e.g. haze pollution or SARS.

INTRODUCTION

International health policy has changed considerably in recent decades. From intergovernmental cooperation within the framework of the World Health Organization (WHO), a complex and confusing landscape of international organizations, international public-private partnerships (IPPP) and powerful foundations has emerged. International organizations such as the World Health Organization have long ceased to be the sole initiator of international health policy.

What role can regions, or more precisely regional organizations, play in the further development of international health policy? If one shifts the view from the global system to regional spaces, it becomes clear that the development of International Health Governance is strongly influenced by regional activities. The development of decentralized structures has become a central element in the development of a global health infrastructure. Regional organizations and intergovernmental cooperation are now playing an increasingly important role in the development of a global health infrastructure. How regions influence international health policy is related to their institutional design. In the context of this work, the Association of Southeast Asian Nations (ASEAN) will be considered. ASEAN is a region characterized by major health challenges and related environmental problems. A prominent example along environmental and health problems is haze pollution. It is interesting to note that civil society actors are now increasingly involved in these regional health and environmental activities. This is not a common practice in the ASEAN region. For a long time, civil society was disconnected from political decisions in most ASEAN member states and was not part of the political process. This situation now seems to have changed. Political decision-makers have recognized that the involvement of civil society in the democratization process in the Southeast Asian states can no longer be avoided. On the other hand, civil society actors such as Non-Governmental Organizations (NGOs) play an increasingly important role in combating community problems, that politics actively promotes the involvement of civil society.

This also applies to challenges affecting health and the environment in ASEAN. Despite these trends towards greater involvement of civil society actors, old patterns still play a major role: NGOs are often excluded from the political process. The following questions are to be taken up and treated on the basis of this ambivalent picture:

> *To what extent do civil society actors in ASEAN drive health and environmental policies? Is there a trend towards civil society-driven governance in health and environmental policy within ASEAN and its member states?*

This question can provide indications of the extent to which a region-specific health infrastructure can be created in ASEAN. The ASEAN institutional structure, which is characterized by the ASEAN Way, needs to be emphasized. In addition to regional actors such as the ASEAN Secretariat, which is endowed with little actor quality, there is the principle of non-interference in member state affairs and the consensus principle, which ensures that progress in policies at the regional level tends to be slow. Legally binding agreements are generally not concluded between ASEAN member states. Disagreements between member states often lead to deadlock for ASEAN. Due to the institutionally anchored blockade potential of the ASEAN Way on the one hand and pressing regional problems on the other, civil society actors have to be given increasing importance in overcoming problems. Thus, a socialization of regional governance seems to be effective. A legalization of governance in ASEAN appears to be developing slowly.

The governance examined here is intended to provide indications of the extent to which ASEAN promotes or impedes the development of regionally functioning health and environmental policies. On the one hand, a blockade attitude could result from the institutional design, the ASEAN Way. On the other hand, there are indications of a trend towards civil society actors having more and more influence and being institutionally involved. These two opposing movements are intended to provide indications of a "health and climate regionalism" in ASEAN and to indicate the extent to which ASEAN, with this pattern of policy-making, tends to promote or rather inhibit the development of health and environmental policy at the international level.

For the analysis, an overview is to be provided of the contribution of civil society actors in regional development along the border between climate and health issues. For this purpose, current institutional developments in ASEAN will be considered, which are primarily evident in the ASCC, aiming to promote environmental and climate challenges and the involvement of civil society actors as well. In addition, both the haze pollution and the SARS crisis pose the greatest challenges for ASEAN at the interface between environment and health. The focus will be on them. Haze pollution is a key challenge that affects both health and the environment. The externalities between states are particularly challenging here: The haze and the related massive air pollution, caused by mostly illegal slash-and-burn agriculture on Sumatra and in the Indonesian part of Borneo (Kalimantan), has been an annually recurring problem for Indonesia and its neighboring countries since the mid-1990s. The smoke caused by slash-and-burn clearing of peatland forests affects the health of an estimated 70 million people per year, resulting in an increase in respiratory diseases, skin rashes and eye infections. In addition, the growing number of slash-and-burn clearances is accelerating climate change. Indonesia is now the third largest emitter of CO^2 in the world[1]. When air pollution reached new record levels in 1997, the most affected countries, Singapore and Malaysia in particular, tried to put the issue on the regional agenda. Legislation and regulations were passed to criminalize slash-and-burn agriculture and its main purpose, the conversion of unlicensed areas into palm oil

plantations. In response to the serious regional consequences of the Indonesian slash-and-burn operations in the spring and summer of 1997, a Regional Haze Action Plan was adopted in December 1997 under pressure from Singapore and Malaysia. On this basis, the ASEAN Agreement on Transboundary Haze Pollution was concluded in 2002[2]. As infectious diseases such as SARS and their spread are, inter alia, related to the climatic environment, epidemics are also at the interface between health and climate[3]. As climate change will affect the ASEAN region, the need for an integrated climate and health policy will become more pressing. The SARS crisis of 2002/2003 can be seen as a turning point for the development of a regional climate and health policy. SARS is a viral respiratory illness that was recognized as a global threat in March 2003. The SARS crisis began in China in early 2002. After its outbreak in China in 2002/2003, SARS spread to ASEAN. ASEAN as a regional actor was caught quite cold by that very epidemic and led consequently to a new institutional setting that should cope with regional challenges[4].

GOVERNANCE OF REGIONS: BETWEEN LEGALIZATION AND SOCIALIZATION

In order to identify which ideas, values and interests lead to joint action by state and civil society actors in the development of regional health and environmental policy, social constructivism is to be used as the theoretical framework. Identities, norms, values are key concepts in this theoretical perspective. The social environment of states is socially constructed and can thus be changed. Preferences are shaped by ideas, norms and identities[5]. Via ideas concepts as "power" but also specific contents like economic policies or health and environment policy given meaning. Interpretation and perceptions of reality determine actions in social constructivism. For that ideas justify actions, goals and means to reach the goals[6].

In order to identify the interests, identities and ideas of the actors involved in health and environmental policy and the current status of the process of a regional health and environmental policy, their governance, within which the actors coordinate themselves, is to be determined. In principle, the concept of governance is related to terms such as "coordination, control and steering" and thus refers to the possible modes of governance, i.e. the coordination or control logics that determine the interaction between actors (states, organizations)[7]. In addition to hierarchical governance logic (command), the classic governance modes include market logic (competition) and networks (negotiations). Pure forms of these governance logics are not to be found either nationally or internationally - they are often mixed forms. For the purpose of this study, the idea is to take up the consideration that international governance develops along the lines of a legalization on the one hand and its socialization on the other. Legalization means that governance at the international as well as at the regional level develops across certain or even all policies along legal principles and norms. Agreements or directives emerge at the regional level and have an impact on the member states of a region, as can be seen in EU legislation. Institutions at regional level have a high level of actor competence in the case of a strong legalization of governance, such as the European Commission or the Council of Ministers. The socialization of governance refers to the participation or institutional embeddedness of civil society or organized civil society in regional policy-making. In particular Non-Governmental Organizations (NGOs) accompany the activities of governmental activities, as can be illustrated by Médecins sans Frontières or the Gates Foundation. Socialization describes the increased involvement of civil society actors such as NGOs, companies or civil society as a whole in coordination[8].

This process of legalization and socialization can thus be transferred to regional governance, as a more or less strong integration process can be observed in regional organizations such as APEC, NAFTA, ASEAN and especially in the EU, according to which various policies such as trade, economy, security are legally developed at regional level and have a uniform effect on the nation-state level of the member states. Civil society is also gaining in importance in very different ways, and NGOs and interest groups are developing their impact at regional level and influencing policy.

Even though agreements have been adopted in the area of haze pollution, regional governance in ASEAN is hardly developed along the lines of a legalization in most policies. Many initiatives have no legally binding effect and can rather be described as soft law. The weakly developed legalization is closely linked to the institutional design at the regional level[9]. The institutional design at the regional level is characterized by the "ASEAN Way", according to which ASEAN is coined by a consensus-oriented policy, which means that the political process is rather slow. The ASEAN Way is accompanied by a 'soft institutionalization' of regional institutions - the ASEAN Secretariat has relatively little power and a correspondingly small radius of action. In addition, the principle of non-interference applies, allowing states to determine their own national policies. Agreements are designed in such a way that in most cases they have no legally binding effect. Agreements at the regional level often exert pressure on the member states in the form of soft law[10].

Due to the rather weak legalization of governance in ASEAN, the question arises as to what extent civil society actors play an increasingly important role. At the regional level, it has become generally accepted that socialization of governance can help considerably if it is to provide answers to existing health and environmental problems. It can be seen that civil society actors in general and especially in the shaping of ASEAN's health and climate policy play an increasingly important role. The socialization of governance thus appears to be playing a greater role in the ASEAN region, as will be analyzed in more detail below.

TRENDS OF A SOCIALIZED REGIONAL HEALTH AND CLIMATE GOVERNANCE - THE DEVELOPMENT OF A THIRD-SECTOR ORDER IN ASEAN

The socialization of governance refers to the involvement of civil society actors in politics. Any organized form of civil society actors, and especially non-profit organizations, are understood as a "Third Sector". Third Sector organizations are civil society or non-governmental actors that have organized themselves to produce services that the state or the market cannot provide. In developing countries in particular, NGOs thus play an important role by taking over state tasks[11]. The role of NGOs is now playing an increasingly important role in the ASEAN region as well, although the slow progress of democratization in ASEAN member states has long hampered the influence of these civil society actors. So far, they have only been involved in state-elitist policies if they have followed certain guidelines. Especially against the background of democratization, the question arises to what extent there is a trend in the ASEAN region towards a Third Sector order in general and in health and climate governance in particular?

The institutional structure of ASEAN, which is characterized by the ASEAN Way, should be emphasized. In addition to regional actors such as the ASEAN Secretariat, which is endowed with little actor quality, there is the principle of non-interference in member state affairs and the consensus principle, which ensures that progress in policy areas at regional level tends to be slow. Legally binding agreements are generally not concluded between ASEAN member states. Disagreements between

member states often lead to deadlock for ASEAN. This can be seen, for example, in the ASEAN Agreement on Transboundary Haze Pollution.

Due to the institutionally anchored blockade potential of the ASEAN Way on the one hand and pressing regional problems on the other, civil society actors seem to be accorded increasing importance in the management of problems. They are no longer excluded from political decision-making processes, as was previously the case. There can be observed a trend towards involving NGOs and civil society cooperating with state actors. This seems to be the beginning of a socialization of regional governance in ASEAN. Since both old patterns of cooperation between state and civil society actors and their exclusion seem to exist as well as new forms of cooperation, a typology will be used to systematically decode these forms of cooperation in questions of regional health and climate policy.

A one-dimensional gradation between cooperation or lack of involvement is insufficient for the analysis of state and NGOs, especially because these relationships have become very complex, as are the reasons for this. Najam summarizes the relations with their different manifestations in such a way that he assumes tensions in state-third-sector relations in principle: "The goals, interests, priorities, resources, and other policy paraphernalia of the NGOs and the government collide - sometimes in harmony, sometimes in discord"[12]. According to the typology, two instruments basically determine the relations between the state and NGOs. Together with the state, NGOs are part of a political process that is shaped by both sides and in which both sides interact with each other. Civil society actors as well as state institutions articulate respective goals, which, depending on the policy, tend to coincide or differ from each other. In order to achieve their goals, both sides pursue individual strategies which, like the goals, are in the same direction or can differ from each other.

Figure 1: Typology of State-NGO-Relations[13]

		Goals: Similar	Goals: Different
Strategies	Similar	Cooperation	Co-optation
	Different	Complementarity	Confrontation

Depending on the orientation of the goals and the strategies used to achieve them, four scenarios emerge which can shape State-Third-Sector relations. Relationships characterized by cooperation arise when both goals and strategies are roughly congruent. Cooperation shows parallels to corporatist structures. In traditional State-NGO-relations, NGOs are guaranteed involvement in politics with the aim of achieving compromises acceptable to all sides in a negotiation process and thus preventing social conflicts. Thus cooperation is originally assumed in the idea of corporatism. Consequently, the strategies pursued in the form of negotiations between the state apparatus and the NGOs are consistent. In contrast to the state of cooperation, a complementary State-NGO-relation exists when the goals pursued are the same, but the strategies pursued differ. This state can be translated into a State-NGO relationship in which the state and NGOs cooperate in the provision of services in such a way that both offer different services that complement each other. If, in addition to the strategies applied, the objectives also differ, the state and NGOs are in a confrontational relationship. Confrontation manifests itself in such a way that NGOs represent and promote a policy in the political system that would not be pursued

without them. In addition, NGOs take a counter-position to state policy and, if necessary, build up a resistance[14]. In addition, in the typology of Najam there is a state which is referred to as co-optation. The state in which the strategies between the state and NGOs are congruent, but the goals diverge, can be observed primarily in developing countries and is understood as a transitional situation. A characteristic feature of co-optation is that the state and NGOs mutually intend to change each other's goals in order to achieve their own goals more quickly. In this model, which party is able to instrumentalize the other side for its own purposes depends on the distribution of power[15]. The goals and strategies, which will be derived along the Najam typology in the following, are intended to provide reference points for how health and environmental policy at the ASEAN level is socially constructed, i.e. which ideas and identities of the social actors underlie health and environmental policy action.

In the following, the institutional design of the Third Sector in the ASEAN region, haze pollution and the SARS case will be examined: to what extent the relationship between the ASEAN member states is characterized by co-optation, confrontation and cooperation along these forms of State-NGO-relations? This provides indications for the development of a Third Sector order in the ASEAN region. Due to the low degree of political integration on the one hand and the existing environmental and health problems on the other hand, the question arises to what extent a regional Third Sector Arrangement is emerging to solve the challenges in climate and health policy in ASEAN?

ASEAN's integrated health and climate governance between cooperation and confrontation

Trends to cooperation

One example is the ASEAN Roadmap, which consists of three pillars. Economic growth, social progress and cultural development are to be pursued along the ASEAN Roadmap. The ASEAN Socio-Cultural Community (ASCC), together with ASEAN Political and Security Community (APSC) and ASEAN Economic Community (AEC), are the three pillars of the ASEAN Charter. The ASEAN Roadmap addresses health and environmental issues with the participation of civil society, particularly in the ASEAN Socio-Cultural Community (ASCC). The ASCC represents the central institutional structure for the further development of health, environmental and climate issues on the one hand and the involvement of civil society actors on the other. One of the main objectives is to establish effective haze management. In addition, against the background of the SARS crisis in 2002/2003, increased attention is paid to epidemics. Based on these formulated goals along the lines of health and environmental policy, the ASCC follows the idea that civil society forces should be increasingly involved in the design of the policy and thus help to develop a regional identity. A specific institutionalization of these goals under public participation are the ASEAN-Institutes of Strategic and International Studies (ASEAN-ISIS), in which different civil society actors such as think tanks or academic institutions come together. One manifestation of ASEAN-ISIS is the ASEAN People's Assembly (APA), which pursues the goal of promoting dialogue and confidence building among policy makers, think tanks and civil society groups in Southeast Asia. Within the framework of ASEAN-ISIS, these civil society groups are to be involved in a range of traditional and non-traditional security issues. These include health and climate/ environmental goals. The APA thus brings together civil society participation in health and environmental policy[16].

The institutional design of ASEAN makes clear that not only state actors should shape policy. The ASCC is becoming an institution in which the path towards a socialization of environmental and health policy has been taken. The APA provides an institutional basis for this. It provides an institutional starting point for a regional Third Sector order in environmental and health policy, since the policy (health and environmental policy) and actors (NGOs) are brought together and not only state actors should shape policy. It should be emphasized that ASEAN-ISIS and APA are network-like platforms in which climate, environment and health issues are interrelated. On the one hand, this is formulated in a very soft and general way, aiming at a joint research on the topic. On the other hand, a public awareness on the topic will be developed[17].

In haze pollution, too, civil society networks have developed over the last 20 years, consisting mainly of academic institutions, think tanks and foundations. ASEAN-ISIS research institutions are also part of this network. Within this institutional setting an international network of experts and scientists from various fields came already together in 1998 to discuss the challenges of land and forest fires and haze pollution[18]. One of the institutional origins for the development of the ASCC blueprint is the ASEAN's response to the SARS crisis in 2002/2003. A large number of meetings between ASEAN-Plus-Three (APT) bodies should lead to the formation of a network. As a result of the SARS epidemic, a network at the regional level was created, which also marked the clear beginning of regional health governance. Through the network, ASEAN or the member states wanted to adapt their regional health infrastructure to the challenges associated with an outbreak. The health network was not only characterized by better links between ASEAN bodies. Civil society organizations were also integrated into the new network, as were commercial enterprises[19].

The lessons learnt from the SARS crisis and the expansion of a network are basically being continued in the institutional development at interregional level. If we look beyond the borders of ASEAN, it becomes clear that the interdependence between ASEAN and other regions has a considerable impact on regional environmental and health policy. Interregionalism is characterized in particular by a high degree of networking between NGOs, as can be seen in the network "Connecting Organizations for Regional Disease Surveillance- CORDS". The dynamics and effects of interregional interdependencies are primarily "Third-Sector driven". The CORDS is an interregional association in which four regions are involved[20]. CORDS links two regional ASEAN NGOs. In addition, as a central network, CORDS links health goals with health objectives by receiving and distributing input (norms, knowledge, etc.) from NGOs outside ASEAN. For the ASEAN region an input of expertise and knowledge about diseases and their surveillance is of high importance. Regional Disease Surveillance measures will become all the more important.

The fact that such a Third Sector dynamic is underway and, above all, that cooperative relations with state actors have developed can be attributed to the corporatist structures that shape the political culture in the ASEAN region. Corporatist structures provide a starting point for network development with the Third sector [21] .

In summary, a trend can be discerned that civil society actors are to be increasingly involved in some interface areas along the health and climate policy chain. This is a movement towards pluralism in the management of health and climate issues, according to which not only state actors but also additional non-state actors should be involved in political decisions and in the provision of public health. Translating this along the typology of Najam, cooperation is based on the common goals in such a way that civil society or organized civil society in the form of NGOs is to be involved in a

common health and environmental policy. This complementary-cooperative relationship is created through the strategy of creating common networks, especially within the framework of the ASCC blueprint, the creation of networks as a result of the SARS crisis and the development of interregional networks, such as within the CORDS. The impact of the Third Sector thus unfolds through networks, which thus acquire a special institutional character (Figure 2).

Trends to confrontation and co-optation in the field of Haze Pollution

It is evident that the overall picture of ASEAN policy is characterized by the opposite directions of action of a people-empowered ASEAN on the one hand and an elite-driven or state-centric ASEAN on the other. For it can be seen that, in addition to the trend of creating a broad basis for cooperation between state actors and NGOs in ASEAN, a further development can be observed in parallel, which is characterized by either confrontation or co-optation between NGOs and the state. This can be traced back to the institutional structure of ASEAN, which is summarized under the "ASEAN Way". It is evident that ASEAN is an elite-driven institution[22]. There is a high degree of cooperation or even consensus orientation at the elite level (consensus principle). In addition, the principle of non-interference applies, allowing states to determine their own national policies. Furthermore, the elites strive to involve civil society actors as little as possible. Rather, an exclusively corporatist coexistence of state and selected social actors is traditionally evident in the member states or at the regional level. NGOs are traditionally systematically integrated into policy-making in such a way that they are supposed to take on a function as QUANGO, i.e. as quasi-governmental organizations[23]. The goals of NGOs are set by the state elite. "It is a top-down process where ASEAN establishes the objectives that the CSOs pursue"[24]. Those NGOs that follow the guidelines are involved at the political level, NGOs with a critical attitude are excluded[25].

This corporatist system is traditionally characterized by the exclusion of critical NGOs by elite state actors. In contrast, NGOs are included if they follow certain guidelines, i.e. only do what is desired. It should be emphasized that "[...] five out of 10 civil society representatives (selected by their peers) were rejected from another official interface session between ASEAN and CSO representatives and their ASEAN heads of government"[26]. The answer to why these structures of an excluding elitist corporatist coexistence have become so established or even consolidated can be found in the role that (institutionalized) regions should have for some member states themselves. This is not only observable in African countries - the behavior of the member states of ASEAN also indicates that the institutions at the regional level are designed in such a way as to ensure that the member states retain their domestic power. Regions should be given the function of a national "regime booster"[27]. Regimeboosting regionalism would thus prevent the implementation of policies at the regional level and promote the strengthening of - mostly autocratic - regimes and their policies at the national level.

Indonesia, as a leading force in the further development of ASEAN, is rather reluctant to further development and integration. As far as the second pillar of the future ASEAN Community, the ASEAN Economic Community (AEC), is concerned, Indonesia's external image as a source of ideas and a motor of regional integration collides with both its policy preferences and its behavior. Indonesian politics shows a protectionist attitude: the economic as well as the political elite continue to position themselves against stronger regional integration, as it could be at the expense of Indonesian sovereignty and endanger the economic location. Large parts of the

integration goals set out in the AEC draft (blueprint) have so far been implemented by Indonesia only incompletely or not at all[28]. This behavior puts into perspective the trend that the pillars along the ASEAN roadmap are less of an institution to be promoted with the help of civil society actors, including climate and health policy. There is thus a danger that ASEAN declarations are often thought of as being high on aspirational rhetoric but low on actual implementation[29]. Thus, the ASCC documents also provide indications that symbolic and discursive action can dominate regional politics. The cooperation of actors at the regional level is rather characterized by "[...] praising the goals of regionalism and regional organizations, signing cooperation treaties and agreements, and taking part in 'summitry regionalism' - whilst remaining uncomitted to or unwilling to implement, jointly agreed policies"[30]. Of course, the symbolic power of summits should not be underestimated, as the example of the European Union shows. However, if we look at the symbolic and summit politics - to put it bluntly - of ASEAN actors within the framework of an excluding regional corporatism, it becomes clear that nation-state regimes use ASEAN institutions to maintain their own power and regime. Even if the ASCC thus also has a solidified political culture of symbolic and discursive action in regional environmental and health policy, the blueprint also attempts to initiate effective joint climate and environmental policy at regional level.

Steering ASEAN towards a regime-boosting region is also relevant to national climate and health issues. From the very beginning, haze policy was characterized by Indonesia's blockade attitude. Indonesia did not sign the ASEAN Agreement on Transboundary Haze Pollution for a long time, which meant that the agreement could not really develop[31]. NGOs also want to be increasingly involved in haze pollution policy, for example in the question of how forest reserves and national parks can be protected from deforestation. However, the political regimes in Indonesia and Malaysia are fighting for supremacy and the question arises whether the governments are able to preserve their dominant role in both public debate and in governance processes in environmental policies or whether the influence of NGOs is increasing. Despite the struggle to gain influence and maintain control, Singapore's political elites tolerate civil society participation in environmental policies because of its environmental vulnerability [32]. This is an indication that states are crisis-driven in these sensitive policies and are seeking partners to overcome these challenges. A tipping point like in Indonesia cannot be observed for Malaysia. And it is precisely because of the rigid attitude of the Malaysian government that NGOs have abandoned their confrontational strategy and subordinated themselves. These policies surrounding deforestation and hare politics in these three states are confronted with politicization by civil society forces and depoliticization, above all by Malaysian and Indonesian policies, which is why the pendulum of state-NGO relations swings back and forth between confrontation and co-optation. The bottom line is that civil society has only a very limited influence on forest policy[33]. In addition, several NGOs, such as WWF Singapore, have started different campaigns to boycott companies responsible for haze pollution or to change consumer thinking[34]. This enables them to create an alternative to government bans.

If we transfer the trends to Najam's typology, it becomes clear that the trend towards a democratized health and environmental policy is accompanied by old state patterns in which NGOs are systematically excluded. These old patterns clash with the goals of civil society actors to be integrated on an equal footing. Cooptation occurs when NGOs are integrated according to old patterns of excluding corporatism, provided that they do not become involved in a critical way, as is clearly shown by the example of haze pollution, in which some NGOs subordinate themselves to state action

or move away from their confrontational stance. They rather become part of a rhetorical cooperation - a rhetorical cooperation is thus decoupled from a factual health and climate policy. Confrontation occurs when the decoupled (rhetorical) climate policy on the part of states is contrasted with civil society initiatives, as can also be observed in haze pollution (see Figure 2).

Beyond the "Asean Way"? The ongoing construction of a Third-Sector driven environmental and health governance

Figure 2: Typology of cooperation between state and civil society

		Goals	
		Similar: *Democratized health and environmental policy*	Different: *De-democratized versus democratized health and environmental policy*
Strategies	Similar: *Involving civil society actors and establishing networks*	Cooperation ▪ *ASCC institutionalization* ▪ *SARS Network/ CORDS* ▪ *AFCC Framework*	Co-optation ▪ *ASCC institutionalization* ▪ *Exclusion of NGOs* ▪ *Haze Pollution*
	Different: *"Decoupling" vs. civil society initiatives*	Complementarity ▪ *ASCC institutionalization* ▪ *SARS Network/ CORDS* ▪ *AFCC Framework*	Confrontation ▪ *Haze Pollution* ▪ *Exclusion of NGOs: excluding corporatism*

What a current social construction of health and environmental policy in ASEAN can look like is shown by the different forms of cooperation that have been developed along the typology in Figure 2. The goals and strategies derived along the Najam typology are intended to provide a starting point for the social construction of health and environmental policy at the ASEAN level, i.e. the ideas of the social actors that underlie health and environmental policy action. The social construction is characterized by a democratized health and environmental policy involving civil society actors up to an undemocratized health and environmental policy excluding civil society initiatives. Thus, the cooperation between state institutions and civil society actors basically presents an ambivalent picture, which is caused by the fact that uniform strategies to achieve these goals have not yet been established. A social construction of a health and climate policy has not yet been completed.

If one illustrates developments in the Third Sector along the lines of the Najam typology, it becomes clear that ASEAN's climate and health policy is largely conducted along cooperative and confrontational state-NGO relationships. In climate and health policy, state and civil society actors seem to be taking a new path. At the same time, however, the old paths continue to exist.

The new paths that have been taken reflect the recognition that civil society forces must be involved in order to be able to cope with regional environmental and health objectives. This creates a pluralistic constellation of actors in which state actors

(member states) and civil society actors seek to remedy health and climate problems at interregional and regional level on the basis of new and old networks. Such cooperation based on a pluralistic constellation of actors can be described as a Third Sector order.

This Third Sector order is increasingly becoming an important component in the further construction of regional governance. With the support of the Third Sector, cross-border problems of nation states can usually be dealt with via networks. The Third Sector is becoming central to regional governance because institutionalization is weak in the majority of regions and state bodies, especially the ASEAN secretariat, are not characterized by power. Political integration has thus progressed rather slowly. The Third Sector can partially fill this "statehood vacuum" - NGOs and the NGO networks become QUANGOs that take on state-related tasks where there is a lack of powerful state institutions - especially in the provision of environmental and health services[35]. The ASCC should be emphasized here as a basic network in which a health and environmental policy is to be promoted with the support of an organized civil society. ASEAN is thus increasingly characterized by a socialization of its governance, in which civil society actors and the state coordinate their activities. The fact that such a Third-Sector dynamic is underway and, above all, that cooperative relations with state actors have been established can be attributed to the corporatist structures that shape the political culture in the ASEAN region. In general, these structures form a basis for network development with the Third Sector[36]. Corporatist structures have existed in ASEAN for a long time and are the institutional starting point for the construction of a Third Sector driven governance. State actors and civil society increasingly share the idea of a democratized health and environmental policy with the involvement of civil society actors.

The fact that the social construction of a Third Sector driven environmental and health governance is not yet complete is shown by the opposing developments away from the ideas and identities of the actors around a democratized health and environmental policy. The relationship between the state and NGOs is still characterized by co-optation in such a way that NGOs are only involved if they follow uncritically defined guidelines and are specifically instrumentalized by the member states. The corporatist structures, which on the one hand are the starting point for the development of networks for Third-Sector driven governance, are on the other hand part of old patterns: numerous civil society actors are excluded through these corporatist structures, which limits the socialization of governance in ASEAN. A greater involvement of civil society actors takes place at a rhetorical level than at a factual level. The ideas and identities of the social actors of a Third Sector driven governance, which follow a democratized health and environmental policy with the involvement of civil society actors, thus currently reach the limits of old paths.

In relative terms, however, it must be noted that NGOs are in a position to break away from this co-optation and enter into a confrontational relationship with state actors. They take a critical stance on politics, which increasingly leads to a confrontational relationship - especially in the area of environmental pollution or haze pollution. This creates a certain political culture at the regional level, in which state and private actors rub up against each other. Only the possibility of civil society to criticize politics shows the first signs of a democratic political culture in ASEAN.

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RETHINKING PROJECT MANAGEMENT FOR CLIMATE CHANGE AND HEALTH IN SOUTHEAST ASIA

Daniel Gilfillan

Globally, negative climate change impacts on public health are addressed using a variety of managerial approaches. In donor-funded initiatives, project-based approaches dominate, however an emerging literature questions the effectiveness of the ***classical project management*** *(CPM) style for complex project environments. Building on this emerging literature, two climate change and health interventions in Southeast Asia are analysed from CPM and* ***rethinking project management*** *(RPM) perspectives. The CPM approach supports better monitoring and reporting, while the RPM approach achieves higher levels of perceived legitimacy, which can foster long-term change. Because of the complexities around both public health and climate change, RPM approaches are particularly relevant. RPM helps to deal with uncertainty and a multiplicity of stakeholders, and better supports long-term sustainability of project outputs and outcomes.*

INTRODUCTION

The impacts of a changing climate exacerbate health related stresses faced by individuals, communities, countries and regions in many ways.[1] For example, salinasation of agricultural lands, more droughts and floods, and more intense storms all affect human health.[2] In the face of these climate related impacts, improved health enhances people's economic potential (e.g. in general, a person who is healthy can earn more money than if they are sick), and at a population level reduces treatment costs. Additionally, healthier people are more resilient in the face of climate related shocks such as floods and storms because they can deal better with the immediate impacts, and recover faster afterwards.[3] In essence, while good health is a powerful adaptation and economic enabler, it is negatively affected by climate change impacts. These positive and negative factors linking human health with economics, social well-being and climate change highlight the powerful causal ties between human health and the three pillars of sustainable development (economic, social and environmental).[4]

When we examine how health related stresses are exacerbated by climate changes, we see that poorer populations and those in less developed countries are much more vulnerable to climatic changes.[5] This increased vulnerability relates to a lack of high-quality infrastructure and services (e.g. clean water supplies, roads giving access to markets and hospitals), and because poorer people tend to have less time and resources to invest in mosquito proofing and preparing for extreme weather events. The research presented here focuses on Southeast Asia, which is home to countries across the full development spectrum, from least developed Cambodia, Timor-Leste, Lao PDR and Myanmar, to middle income Vietnam, Thailand, Indonesia and the Philippines, and on to the developed countries of Singapore and Brunei.[6] The range and variety in income levels and development across the region makes Southeast Asia a compelling part of the world

in which to explore how health sector focused adaptation to climate change is being implemented and supported.

Southeast Asia, including both least developed and developing countries, receives a significant proportion of official development assistance (ODA). ODA is financial assistance that is provided via bi-lateral and multi-lateral institutions.[7] Over the period 2009 to 2019, ODA to the eight developing Southeast Asian countries, from Development Assistance Committee countries and multilateral organizations, ranged between 5.16% (in 2009) and 3.39% (in 2016) of global ODA given by these sources.[8] Institutions providing ODA funding need to know that the money is being used in the ways it was intended, and that it is delivering the intended outputs and outcomes. To facilitate this oversight, the majority of financial assistance is delivered on a project basis, because project management protocols are designed for reportability.[9] Project-based approaches to development assistance follow classical project management (CPM) tenets of task and results oriented simplicity and controllability.[10] There are alternatives to project-based development approaches, with governance-based support focusing more on institutional building through bringing together government officials from different regions and countries to discuss, for example, mutual environmental health concerns.[11] Development initiatives tend to fall on a project-governance spectrum, meaning that while the predominant approach may be project-based, that it is still likely to incorporate governance elements and ideals (and vice-versa).

This paper uses a case-study of health sector climate change adaptation interventions in Southeast Asia as a basis to explore the benefits and pitfalls of the two approaches. In doing so, it highlights that each approach has strengths and weaknesses. This paper adds to recent work that advocates for new approaches to project management, including those built on iterative assessments and applications to take into account uncertainty and change.[12]

THEORY

Public health and climate change

The World Health Organization (WHO) defines public health as "improving health, prolonging life and improving the quality of life among whole populations through health promotion, disease prevention and other forms of health intervention".[13] WHO also recognizes that people's lifestyles and living conditions have a strong influence on their health, concluding that creation of health enabling environments is needed to support achievement of beneficial public health outcomes. Similar to climate change adaptation work being future focused, addressing public health issues is about what can be done now to reduce future health related burdens. Thus, the adaptation and health literature, as well as public health literature, include arguments for health authorities to play a role acting on health determinants, including in areas outside health authority mandates. Some, for example, argue for health authorities to fill guidance and coordination roles in areas including disaster risk management, climate change adaptation, and development more broadly, in ways that could help build health system resilience in the face of global climatic change.[14]

Climate change and health in Southeast Asia

Average temperatures across Southeast Asia have risen around one degree centigrade since the 1960s, and the region is also seeing increasing numbers of hot days and warm nights.[15] In addition to these temperature related changes, broadly, Southeast Asia is experiencing more rainfall during shorter monsoons seasons, and longer, drier dry seasons. For example, regional projections highlight an increase in rainfall extremes during monsoon periods,[16] which is linked to increases in annual flooding. Similarly, drier dry seasons are linked to more extended droughts, such as the 2015-2016 drought in the Mekong Delta, which had a significant impact on Vietnam's rice exports.[17] In terms of extreme weather, northern Southeast Asia is being faced with more frequent extreme events, while southern Southeast Asia is experiencing declining numbers of events.[18]

Southeast Asian populations are vulnerable to climate change impacts because of population density, high population growth rate, and a heavy reliance on agriculture for livelihoods.[19] Rural dwellers who rely on agriculture tend to be poorer and thus more vulnerable to climate change impacts. In the Mekong Delta, for example, there are around 4 million people living in poverty, mostly in rural areas, who do not have safety nets in terms of health, and whose children have below average school completion rates.[20] Poverty is linked to vulnerability because poor households tend to be located in less desirable settings such as flood prone areas, and also because poor people have less resources to invest in mosquito proofing their houses or ensuring they have access to filtered water. Poorer households also have fewer resources to deal with climate change impacts. For example, in the 2015-16 drought in the lower Mekong, it was estimated that around 300,000 families lost their annual rice derived income (pers. comm. April 2016). In these cases, wealthier families can use savings to tide them through the drought period, and are also more likely to have more than one income source. In contrast, an extended drought is much more likely to cause a poor family to suffer malnutrition. Similarly, poor families have less ability to pay for medical services and ancillary costs such as transport to a hospital, or accommodation for the sick person and family members during a hospital stay.

In addition to these vulnerabilities that link to climate change impacts, Southeast Asian populations are at increasing risk from climate sensitive diseases such as dengue and diarrheal diseases. As an example, both Hsieh and Chen and Phung *et al.* have observed correlations between rainfall and temperature peaks and increases in hospital admittances for these types of diseases.[21] Diarrheal disease outbreaks are often also associated with drought conditions, because people lack access to clean water. It is therefore not surprising that vector and water borne disease issues feature prominently in climate change and health related policies and strategies in Southeast Asia.[22]

Project management

Project management is used extensively by organizations to help them achieve organizational goals and objectives through maintaining control and managing use of resources.[23] CPM has five different functional areas ranging from project initiation, planning and execution, through to monitoring and reporting. In general, a project is deemed to be successful if it ran on time, within budget, achieved the desired results, used resources efficiently, and was acceptable to the customer.[24] This description of CPM

highlights its linear nature, and its focus on simplicity and controllability.[25] There are weaknesses with this type of project management however. For example, project management theorists argue that managing multiple projects simultaneously brings forth challenges that differ fundamentally from those that arise when managing single projects. In relation to these challenges they refer to ideas of complexity and adaptive systems.[26]

The weaknesses of CPM are further highlighted for projects being implemented in developing countries where ODA is used to pay for many climate related interventions. CPM approaches are not ideally suited to the complexities that can arise when the funding organization is not the same as the organization for whom the work is being done. For example, a funding organization prioritizing the CPM tenets of simplicity, controllability, and linearity, can lead to project legitimacy being questioned by, for example, a government agency for whom the project is being implemented. The questioning of legitimacy can occur because the CPM focus on simplicity and controllability can exclude a national government agency, for example, from full involvement in project design and management of its implementation (because the extra involvement can significantly increase complexity of decision-making).[27] Where project legitimacy is questioned in this way, frustrations can result, which can raise significant obstacles to project implementation.

The ideas presented above, from theory and practice, both feed into new ideas being proposed in project management theory that tie it much more closely to iterative models for climate change adaptation. For example, recent arguments in the project management literature are calling for rethinking project management (RPM) approaches that should be more effective in complex settings. RPM addresses complexity by incorporating ideas of learnability, multiplicity, complexity, uncertainty and sociability.[28]

THEORETICAL FRAMING

This research was done from the perspective of two inter-related theories. The first is resilience thinking, which is fundamental to much sustainability research, with its focus on recognizing that external environments change continually, requiring entities to adapt continuously and iteratively.[29] This is particularly pertinent when considering climate change and the already emitted greenhouse gases that are still causing temperature and sea-level to rise, as well as ocean acidification and other direct and indirect impacts that affect human health. In this research, resilience thinking helped to understand the broader environmental that the target organizations work in, as well as for examining the ways that project management approaches can best support sustainability ideals. The second theoretical underpinning of this research is modern organization theory, which focuses on interactions within organizations. For example, modern organization theory considers how individuals operate within broader organizational systems and processes, as well as how individual units in an organization interact with each other to achieve organizational goals.[30] In this research, modern organization theory provided insights both within individual organizations, and across organizational boundaries. For example, the use of modern organization theory focused attention on the hierarchical CPM-based inter-organizational communication chain shown in Figures 1, as well as the less hierarchical, but more complicated RPM-related communication chains in Figure 2.

METHODS

This research linked project management with climate change and health. This was done by building on a case-study of two regional interventions designed to address climate change impacts on human health, including supporting health sector adaptation to climate change. The two case-study interventions adopted contrasting approaches to supporting health sector adaptation, with one using CPM techniques, and the other working with governments in Southeast Asia to establish an inter-governmental panel to leverage climate change and health related change. This research used analysis of academic and grey literature on project management and on climate change and health as a basis to evaluate and analyze the two interventions for their strengths and weaknesses. In particular, the interventions were analysed from a CPM perspective as well as from the more recent RPM perspective. The research adopted a qualitative approach to match the case-study on which the research was built.

RESULTS

Despite much research into relationships between climate change and health,[31] as well as research about what is being done about it,[32] there is a scarcity of case-study examples of interventions to address these issues in Southeast Asia. In the grey literature, the Asian Cities Climate Change Resilience Network has reported on projects of theirs that included climate change and health elements,[33] with one city-level Southeast Asian example written up independently as a case study.[34] In another example, the climate change and health interventions of two regional Southeast Asian organizations were compared.[35]The results and discussion presented below, build on this second example by overlaying project management theory on the findings and analysis of the research into two different approaches to climate change and health support in an international development context.

This results section of the paper outlines the salient aspects of this case-study that were examined in this research from the point of view of the governance and project-based elements included. The subsequent discussion section then examines the results in light of the theoretical framing of the paper and in light of established theory on climate change and health as well as established project management theory.

Two regional organizations' climate change and health interventions

The research presented describes and analyses two Southeast Asian interventions to improve health sector adaptation to climate change.[36] The first intervention was an Asian Development Bank (ADB) project that was implemented in three greater Mekong subregion (GMS) countries (Vietnam, Lao PDR and Cambodia).[37] The second intervention was the climate change thematic working group, initiated and supported through the Asia Pacific Regional Forum on Environment and Health (APRF).[38] The forum had a membership of 14 countries in 2016,[39] and opened this up to a further 20 countries at the APRF's three-yearly forum that was held in Manila in October 2016.[40]

The two initiatives have different operating principles. The ADB initiative had US$4.4 million of funding provided by the Nordic Development Fund. Its goals were to reduce vulnerability to climate change impacts among poor, migrant and ethnic minority

populations in the GMS, as well as climate related capacity development for national health agencies.[41] It was established as a three-year project with a set timeline of activities and objectives to achieve, including submission of regular administrative and technical reports on the part of the project implementing agency.[42]

The APRF's climate change thematic working group (CCTWG) is a forum for health and environment ministries of countries in the region to meet and discuss climate change and health related issues of mutual interest. The CCTWG has similar goals to the ADB initiative, with its objectives including to:[43]

- Enhance knowledge management related to re-emergence of infectious diseases due to climate change;
- Strengthen research capacity around links between environmental change and human health; and
- Encourage measures that will limit the impacts of climate change on human health.

However, despite the similarity of the goals, as a forum for discussion, the CCTWG does not have specific goals or timelines, and does not have funding to implement actions discussed at the forum. Rather, the CCTWG purpose is to build ownership and a sense of responsibility for dealing with these issues within member country bureaucracies and governments.[44] Despite having powerful aspirations and strong links to government agencies, the CCTWG has not been achieving its goals, at least partly because of the lack of goals, timelines and objectives that provide a compelling incentive to prioritize work as well as ensuring consistency of direction. For example, Biermann *et al.,* and Dahle both highlight the importance of international treaties and other initiatives having clear and well-articulated goals and objectives.[45]

The ADB health and adaptation project has made progress, but has still had a number of significant issues. The design of the ADB project came from within the bank, with the health ministries in the three countries consulted during the process. Additionally, in general the ADB does not implement its own projects, and in the case of the GMS adaptation and health project, a third-party consultancy firm was contracted for implementation. The extra layer of management and reporting undermines flexibility and responsiveness, because the implementing agency has contractual obligations to the ADB rather than to the government partner agency.[46] Because of limited involvement in project design, and the rigidity engendered by contracting a third-party implementer, national government agencies involved in the ADB's GMS health and adaptation project were left feeling that they were treated as a pathway to achieve project goals, rather than being a partner in the process.[47] Perhaps partly because of this, at the end of 2019 the project had already overrun its original project timeline by twelve months, with 40% of the project budget still to be spent.[48]

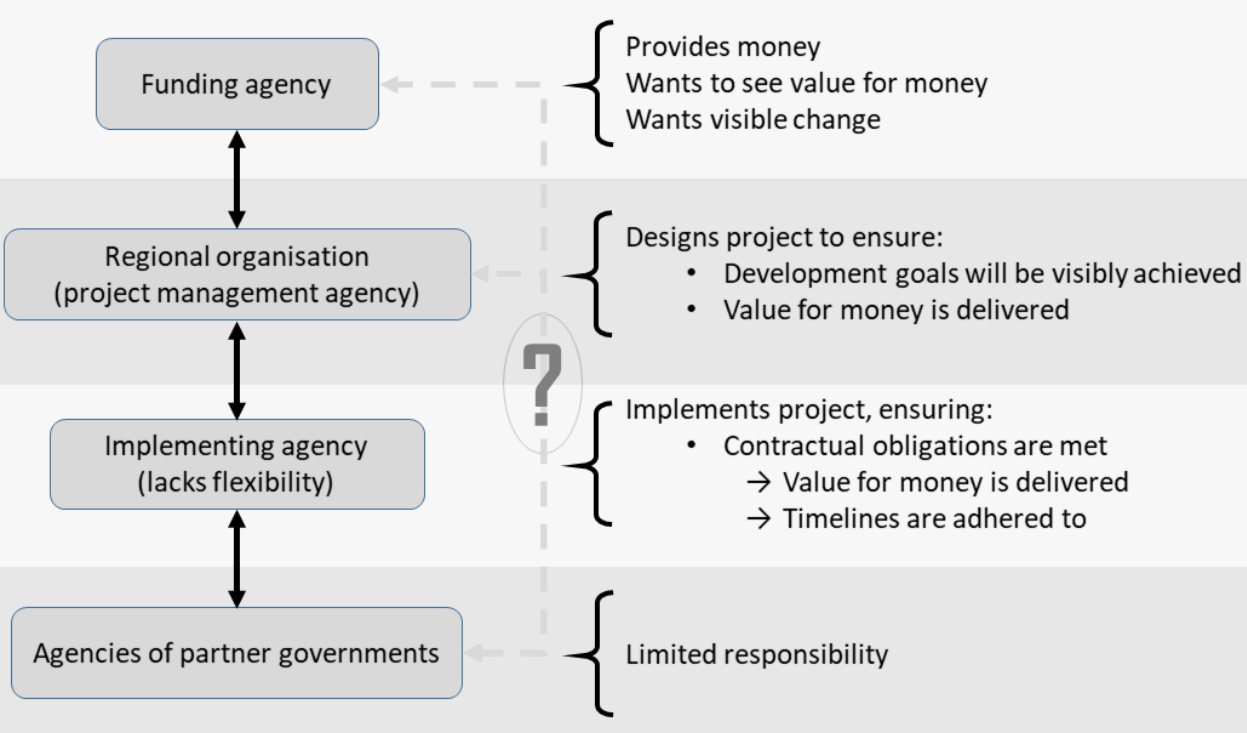
DISCUSSION

As outlined in section 3.4, the academic literature on project management recognizes that there are weaknesses in classical linear project management approaches. The ADB component of the case-study described above highlights some of these weaknesses in practice, particularly in terms of the rigidity of the approaches used.

Insights from the case-study

In line with CPM approaches,[49] the ADB project implementation was driven by a need to satisfy donor requirements and contractual obligations. This puts pressure on the project manager to achieve project goals on time and within budget (or to justify cost or timeline overruns to donor agencies). In terms of project management, these issues are compounded in an international development setting because there are often three organizations in addition to the client for whom the project is being implemented, and because there are limited linkages between the different organizations. For example, Figure 1 shows a typical hierarchical communications structure between four different organizations involved in donor-funded initiatives, and the lack of easy communication between, for example, a national government agency and a multi-lateral development bank.

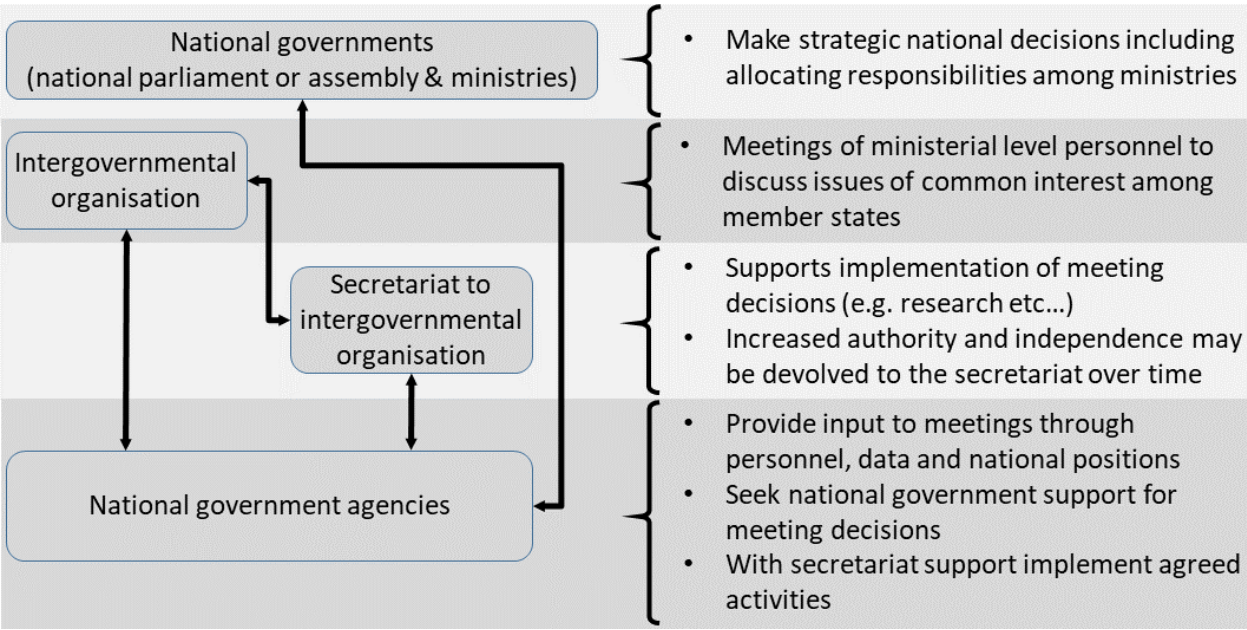
Figure 1: Arrangement for project-based support for climate change and health projects



In contrast, the APRF component of the above study shows that, despite lack of funding and lack of specific objectives and targets undermining performance, there are advantages to alternative approaches, such as the governance approach that this environmental health forum has favored. The advantages of the governance approach derive primarily from the focus on building national ownership of the process, as well as responsibility for outputs, with these leading to higher levels of perceived legitimacy for the initiative. Legitimacy is a key area of concern in ensuring effective project implementation because, for example, when a national government agency views the project implementation chain as legitimate they will be significantly more likely to

actively support it.[50] The perception of legitimacy in the APRF case was the result of government agencies driving the planning and design processes, and being partners during implementation. Figure 2 shows the stronger linkages between the different organizational elements involved in a regional level governance-based initiative.

Figure 2: Arrangements for governance-based support for climate change and health projects



Applying project management theory to the case-study insights

In CPM, stakeholders including partner government agencies, have an important role. However, this importance is often more theoretical than actual, as the implementing agency's need to achieve visible project results can outweigh the need to collaborate with and seek continual input from the beneficiary organization. This can particularly be an issue in an international development environment, with multiple parties involved in project funding, management and implementation, and where these parties are all different to the beneficiary organization. Because of this, the research presented here provides a timely examination of how project management can most usefully support the implementation of initiatives in these types of circumstances.

While some authors argue that CPM is the dominant approach within project management as a discipline,[51] this cannot be assumed. This is because project management literature highlights a growing interest in rethinking approaches and additionally, project managers are invariably looking at how to best achieve their goals and objectives.[52] For this reason, this research examined the two case-study initiatives for their CPM and RPM aspects (Table 1).

Table 1: Comparing ADB and APRF initiatives against CPM and RPM

	Characteristic	ADB initiative	APRF initiative
CPM Tenets	Specific	☑ Yes – the ADB initiative had clearly stated goals and objectives	◈ Partial – the APRF initiative has a set of clearly stated goals, however there was a lack of specific objectives underpinning the goals
	Measurable	☑ Yes – the goals were attached to timelines and reporting systems	☒ No – the lack of timelines makes measuring progress challenging
	Achievable	☑ Yes – the initiative included a clear plan of action to achieve its goals	◈ Partial - The goals were achievable, but the lack of timelines and lack of action plan undermined their achievability
	Realistic	☑ Yes – the initiative used a standard reporting cycle ensuring objectives could be achieved	☒ Because of difficulty in measuring progress and the lack of certainty about achievability, the objectives of the APRF initiative were not considered realistic
	Timebound	☑ Yes – there was a specific period for project implementation (although it was extended); reporting timeline enabled easy reporting	☒ No – the initiative did not include a timeline for when objectives were to be achieved and did not have a reporting format
RPM tenets	Learnability	☒ No – the project did not allow emergence of goals during project implementation	☑ Yes – government officials met to discuss climate change and health issues of mutual interest, providing opportunities for learning
	Multiplicity	◈ Partial – while differing national circumstances were incorporated in project design, the design work was all done by the ADB	☑ Yes – government agencies from the countries involved were all party to defining goals and objectives, so they could be relevant to all
	Complexity	☒ No – the project had a single set of goals that were determined by the ADB prior to implementation	☑ Yes – complexities were supported by placing responsibility for acting on initiative outcomes with national government agencies
	Uncertainty	☒ No – the project did not adopt an adaptive	◈ Partial – the initiative allowed discussion of uncertainty, but

		management approach designed to incorporate new information or to adjust the direction of the project during implementation		did not explicitly include adaptive management approaches for incorporating new information into project goals and objectives
Sociability	☒	No – the project implementation led to frustrations in beneficiary organisations	☑	Yes – the model used built credibility and legitimacy of the process

Rating System: ☒ No; ◈ To some extent; ☑ Yes

In the case-study examined it was observed that the project management approach adopted by the ADB included a variety of advantages that match well with CPM. Similarly, the analysis in Table 1 shows that the benefits of the approaches used in the APRF initiative fit well with the characteristics of RPM. As observed in the case-study, both approaches had weaknesses as well, highlighting the recognition in the project management literature that RPM should be viewed as adding to classical approaches, not as a different approach.[53] The arguments in the case-study publication, that the ADB and APRF approaches to implementing climate change and health interventions should be combined to enhance human health outcomes in the face of climate change, directly support arguments for rethinking project management.

Analyzing the advantages and disadvantages of RPM approaches for the case-study

In the case-study presented in the result section, it was argued that the two principal organizations involved in the two initiatives (the ADB and the APRF) should improve their inter-organizational coordination by assigning responsibility for coordination to individual departments, and that the APRF initiative be used as a base for trialing a combined approach.[54] The rationale was that the APRF climate change and health initiative is seen as important by member countries, but is in need of re-invigoration. Additionally, relationship building and dealing with issues like complexity and multiplicity can be more time-consuming and challenging to initiate than the simpler CPM approach. Because of this, the APRF initiative would provide advantages as a platform to implement RPM approaches for climate change and health as it has already addressed the "new" RPM tenets. However, it is important to assess the likely advantages and disadvantages associated with the added project management complexity. Because the ADB initiative was implemented using a CPM approach, it has been chosen here as a basis for comparing the advantages and disadvantages of each approach (Table 2). The analysis presented in Table 2 draws on the analysis of the two initiatives examined in this research to develop indicative cost elements and pros and cons for each project management approach.

Table 2: Assessing the Positive and Negative elements of the CPM and RPM approaches to the ADB's climate change and health initiative

	CPM		RPM	
Item	**Cost elements**	**Pros/Cons**	**Cost elements**	**Pros/Cons**
Project design	Done "in-house" at the ADB: Primary cost is staff time	Pros: Cheaper and quicker Cons: Less "buy-in" from national partners	Collaboration with 6 government ministries in 3 countries, Primarily via tele-conferencing and email, one or two face-to-face meetings	Pros: A common understanding between different stakeholders about project goals, objectives and anticipated outcomes Cons: Time-consuming and more expensive
Selecting an implementation agency	Staff time to prepare documents for contractor-selection process through ADB consultant management system, and to assess applications	Pros: Cheaper and quicker Cons: National partners do not have a voice in choosing who implements the project	Government agencies involvement in document preparation and assessment of submissions	Pros: National partners have a stronger understanding of project establishment; have a good understanding of the capabilities of the implementing organisation and stronger basis for collaborative work Cons: Recruitment of implementing agency is significantly more complicated
Project Implementation	Significant international & national consultant input; Stakeholder meetings to establish and manage project direction	Pros: Established process is well understood and controllable Cons: The hierarchy of organisations/contract makes changing project direction challenging	National partner agency involvement in project management, supported by international and national consultants; Regular meetings between national partner agencies & ADB	Pros: More involvement by national partners should lead to stronger understanding of project details and higher ownership of project outputs Cons: More agencies involved makes it more challenging to meet agreed timelines; Possibilities for projects to move in substantially different directions in each country

Table 2 highlights that there will be additional costs and time inputs in the earlier stages of implementing an international development project, such as a regional climate change and health project, by using RPM. However, these additional costs will pay-off later in the project with the additional involvement and understanding among national partner agencies. The pay-offs will come in terms of likely reduced project implementation costs (because of less need of international and national consultants), as well as in a higher likelihood of the project having long-term outcomes and influences.

Future research

To the best of the author's knowledge, this is the first research that links an assessment of climate change and health interventions with research into project management. This link is particularly relevant and timely given the growing importance being accorded to climate change impacts on human health. Given this growing importance, and the lack of existing research into climate change and health interventions, there are two key areas identified here for future research:

- There is a need for more case-study investigations of climate change and health interventions, particularly in the developing world;
- There is a need for economic evaluations of RPM approaches, quantifying the costs and benefits outlined in this research, in order to help project management organizations to justify using RPM approaches.

CONCLUSION

This paper makes four contributions to the existing literature about responding to climate change and health impacts, and about styles of project management used in climate change and health interventions. Firstly, this paper highlights that there is a heavy emphasis in climate change and health research on assessing impacts, with a lack of research exploring the effectiveness of climate change and health interventions. While research about climate change impacts on health is vital, its role is to inform responses, and there is a need for additional assessments and understandings of these responses. Secondly, the research presented here builds on a published case-study of climate change and health interventions and links these to project management theory, highlighting the importance of project management approaches in managing climate change and health interventions. Thirdly, this research has used a comparative real-world case-study to show the value of incorporating RPM approaches into project management. Fourth, while this research focused on climate change and health, the findings of this research are applicable to project management more generally. This research adds to existing arguments calling for a rethinking of project management by presenting a case-study example that examined two climate change and health interventions with large geographic overlaps, but which used approaches that fit well within the CPM and RPM project approaches.

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