Current Crises and Potential Conflicts in Asia and the Pacific: Challenges Facing Global Health or Global Public Health by a Different Name

Frederick M. Burkle, Jr., MD, MPH, DTM, PhD (Hon.), FAAP, FACEP[1,2,3]

1. Professor (Ret.); Senior Fellow & Scientist, Harvard Humanitarian Initiative, Harvard University and Harvard T.H. Chan School of Public Health, Cambridge, Massachusetts USA
2. Senior International Public Policy Scholar, Woodrow Wilson International Center for Scholars, Washington, DC USA
3. Elected Member, Institute of Medicine, National Academy of Sciences, Washington, DC USA

Correspondence:
Frederick M. Burkle, Jr
Harvard University - Harvard Humanitarian Initiative
14 Story street 2nd Floor
Cambridge, Massachusetts 02138 USA
E-mail: skipmd77@aol.com

Conflicts of interest/presentations: Presented at the "Institutional Coordination in Disaster Management in the Asia Pacific" Conference; April 2018; University of California at Berkeley APEC Study Center & the University of California San Diego Medical School; California USA. The author has no conflicts of interest to declare.

Keywords: Asia Pacific; crises and conflict; global public health

Abbreviations:
ADB: Asian Development Bank
APAC: Asia and Pacific countries
CHAN: China-Harvard-Africa Network
ESCAP: Economic and Social Commission for Asia and the Pacific
GRRPS: Global Risks Perceptions Survey
IHL: international humanitarian law
NOAA: National Oceanic and Atmospheric Administration

Received: July 8, 2019
Accepted: July 13, 2019

doi:10.1017/S1049023X19004953

Abstract

Since 1945, the reasons for major crises and how the world responds to them have changed every 10-15 years or sooner. Whereas these crises vary greatly across global regions, their economic, environmental, ecological, social, and disease aspects are increasingly under the influence of widely integrated global changes and forces arising primarily from: climate extremes; rapid unsustainable urbanization; critical biodiversity losses; and emergencies of scarcity in water, food, and energy. These slow-moving but increasingly severe crises affect larger populations across many borders and lead to the emergence of increasing population-based, preventable public health emergencies related to water, sanitation, food, shelter, energy, and related health illnesses, and ultimately global health security. This report explores the impact of these crises on Asia and the Pacific region, and their potential for regional conflict.

Burkle FM, Jr. Current crises and potential conflicts in Asia and the Pacific: challenges facing global health or global public health by a different name. *Prehosp Disaster Med.* 2019;34(6):653–667.

Introduction

Asia and Pacific countries (APACs) include Australia, Bangladesh, Cambodia, China, Fiji, French Polynesia, Guam, Hong Kong, India, Japan, Korea-South Korea, Laos, Malaysia, Micronesia, Myanmar, New Zealand, Pakistan, Singapore, Taiwan, Thailand, and Viet Nam. The APACs defined by the Human Development Index that represent a significant share of the world's economic production and population to assert power as an economic block include the BRIC (Brazil, Russia, India, and China) and the MINT countries (Mexico, Indonesia, Nigeria, and Turkey). The ascendency out of poverty in Asia and the Pacific region has proven both unique and worrisome, especially as it pertains to health and public health security. For example, the incidence of poverty in China in 1981 declined from 85% to 27% in 2004, a reduction of slightly more than 600 million people, primarily accomplished through rapid industrialization and village-based poverty targeting.[1] While China produced a faster change from poverty than any country in history, their understanding of essential public health requirements lagged vastly behind industrialization and was never given the same priority. That lack of coordination and collaboration remains evident today, placing China under a different microscope, one of greater scrutiny and judgment from the global community who sees their many poor health outcomes, especially related to air pollution, prompting many in China and the world to ask "at what price?"[2]

In 2010, there was water scarcity in two-thirds of China's 600 cities, 80% had no sewage treatment facilities, the food security program is unsustainable, 90% of groundwater is polluted, and major rivers have had their downstream microorganism ecology altered by chemicals and fertilizers dumped by industry and cities into the water resulting in new and reemerging diseases. In August of 2016, President Xi's economic address tied to security concerns called for "full protection of people's health, stressing that public health should be given priority in the country's development strategy."[3] An independent survey of the Chinese citizenry two months later revealed that while the Chinese public agreed with Xi's need to promote China's more influential role in the world, they raised grave concerns about environmental safety, numerous high-profile scandals regarding unsafe medical and food products, and water and air pollution.[4] China's story mirrors that of other developing countries in Asia, the fastest growing region in the world, in that government spending on public health is inadequate and not focused on those who need it the most. While the region

is on-track to achieve the Millennium Development Goals it aspires to economically, this is not the case for reducing malnutrition and maternal mortality,[5] a domestic disconnect that challenges China's understanding and commitment to their development assistance for "global health" that emphasize commercially driven primary care and infrastructure engagements.[6]

After a decade of debate, started in the late 1980s, over what global health represents and what it doesn't, interested parties desperately sought a common definition. In 1994, the prestigious journal *The Lancet* called for the adoption of the "specialty" of global health as one that focuses on issues that "directly or indirectly affect health that transcends national borders." The accepted definition was designed to help settle what had become a stifling argument among specialists whose aim was to come to an agreement over "global" in contrast to "international," and further concluded that public health, per se, only focused on the health of the population of a particular community or country.[7] Admittedly, the debate over what constitutes the definition of global health will undoubtedly continue, as it did in 2013, when the contested issue surfaced on whether "health equity should be explicitly defined as a goal of global health or a new public health."[8] While this debate had come to some semblance of closure in the form of a working definition, meeting expectations of what the world understands is the prerequisite for good health outcomes, defined as "global health," is only met when: *essential public health infrastructure for water, sanitation, food, shelter, energy, health access and availability, protections* for *vaccines, maternal and child health, and mental health programs, their supportive legislation and funding, and recordable outcome measures exist*. Only then will the touted economic and political successes of a nation gain the credibility of its now "healthier population," which to date has not only failed to be accomplished, it has lost dangerous ground.

Unfortunately, in this debate, we lose an important link and understanding in what defines global health when we attempt to assume that unaccomplished public health advances belong only to developing countries and that a state of global health already exists to economically developed ones. Global health's sensitive indicators and their epidemiological outcomes are influenced by both politics and governance. Indeed, in the United States, it is common knowledge, supported by epidemiological studies, that an individual State's maternal and infant mortality rates fluctuate with the political party in power.[9-11] Similarly, for too many developing nation-states, the politically and economically vulnerable status of their public health infrastructure and programs are best avoided or put-off for another day.

Public health essentials, and the ability to maintain them for the entire population, should be a common denominator in defining a country as economically "developed." It is no easy task. Understandably, confusion reigns among the millennial population who increasingly see themselves less as nationalists limited by borders and more as global citizens who carry the banner of global health improvements, not just economic ones. As such, they recognize that both direct and indirect dire consequences to the health of a population occur when protective thresholds in public health are absent, destroyed, overwhelmed, not recovered or maintained, or denied to populations by the myriad of crises that have already occupied their lives.[12]

Historically, principles that define global health can be attributed to Sir William Osler, who in 1906 emphasized that "medicine is the only world-wide profession, following everywhere the same methods actuated by the same ambitions, and pursuing the same ends." Yet, throughout his clinical life, he characteristically placed particular emphasis on the rise of preventive medicine and sanitation and the "epoch-making discoveries of Jenner, Pasteur, Koch, Lister, and others," which, when discovered and termed "public health advances," became the core accomplishments that first defined global health expectations. First the community, then the nation, and then the world advanced. Global public health was that expectation that Osler always looked to in his vision of a "world-wide profession."[13] It is suspect that Osler today would find that the artificial divisions defining global health limits ones thinking in pursuit of what each and every public health advance is called on to do. It would be a great loss if all public health professionals ceased seeing themselves as protectors of the global health. Global health expectations of today will not be realized until public health infrastructure and protections are made available in society, first as an element in health outcome progress, and eventually as a universal human right. Today, Osler would not say otherwise.

Indirect or Preventable Health Protections under International Law

The most common public health challenge for the 20th century and the beginning years of the 21st century has been to improve the health status of populations caught in the cycle of war, intimidation, hunger, migration, and death. The direct health consequences of civil strife are identified as death, injury, disability, sexual assault, and psychological stress. The indirect/preventable health consequences are identified as mass migration, food shortages, hunger, and the collapse of health and public health services.[14] No one can deny that all wars, both national and international, result in the loss of essential public health infrastructure and protections.[15-17] Many who spent their careers working for international organizations in wars and complex humanitarian emergencies post-WWII recognized early on that all wars rapidly become public health emergencies. They studied each war to capture how quickly and varied public health crises developed when the essential public health infrastructure was destroyed or protections to the most vulnerable populations (children, women, elderly, and disabled) were denied, ceased to function, or were lost. Health care providers were taught that it was crucial to seek, identify, and monitor those victims who presented to health facilities with ailments other than war-related trauma as emerging preventable/indirect diseases due to destroyed or failing public health infrastructure and protections. These cases usually resulted from the abrupt changes in sanitation, water, shelter, food, health access or availability, and either obsessive heat or cold weather. Compared to direct mortality and morbidity of war or armed conflict as the measured outcome from weaponry, the "indirect or preventable mortality" consequences from destroyed essential public health infrastructure and protections will predictably account, over time, for numbers that exceed those from war weaponry by 50%-70% or more.[16] Nor is it any different in post-hurricane devastated Puerto Rico, where the official daily mortality data averaging 82 deaths rose to 118 as public health essentials in power, water, food, and medical care remain severely compromised and the Island's only suicide prevention hotline is extremely busy.[18] Disasters keep communities honest by their uncanny ability to immediately define the public health and expose their vulnerabilities.[19]

When cross-border wars were more common, our forefathers in the 19th century Geneva, Switzerland predicted the dire public health outcomes and their impact on civilian populations when

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

writing the 1949 *Geneva Convention* IV. Under Articles 55 and *56*, international humanitarian law (IHL) requires occupying powers "to the fullest extent of the means available to it" to ensure the "public health and hygiene in the occupied territory." The IHL references the adoption and application of preventive measures necessary to combat the spread of contagious diseases and epidemics, provide food and medical supplies as necessary to the population; and agree to relief schemes and facilitate them by all means at its disposal.[20] Although these IHL provisions are well-known to the humanitarian and public health communities for decades, it is rarely appreciated by political decision makers of the current generation who can be inhibited by the outlay of time, personnel, and funds required to restore such infrastructure. Indeed, a glaring example occurred in 2003 when the US Government, whose initial plan was to leave Iraq within three weeks' time, claimed to be "liberators," not "occupiers," purposely forgoing any responsibility under the *IV Geneva Convention*, resulting in over a decade-long list of indirect/preventable mortality to occur.[21] In the current war in Syria, the same IHL mandates have been ignored.

While preventable mortality and morbidity predictably occur in war and armed conflict, it also shows its ugly head in the lack of recovery and rehabilitation of sudden-onset natural disasters and public health emergencies of international concern, such as the 2014 Ebola epidemic. Unfortunately, in many developing countries suffering prolonged conflict, especially those in Africa, the destroyed public health infrastructure is rarely recovered post-conflict before 10 years' time, or more.[22] As the nature of war changed from primarily interstate to internal conflicts, unprecedented massive number of migrants and refugees followed, a process endemic today to both the Middle East conflicts and North African droughts, which in 2015 exceeded 65.3 million (or one out of every 113 people on Earth), with over one-half under the age of 18 years.[23] Those public health responsibilities are then passed to refugee accepting countries, many themselves unprepared to mitigate the public health dimensions from this influx of humanity, and they quickly become a public health emergency in their own right.[24,25] The current status to avoid disparities in health services access and availability between migrants, refugees, and the host population is historically unprecedented, and represent a "global public health emergency" that all regions of the world remain susceptible to in increasing numbers.[26]

Vulnerability in the Asia and Pacific Region

Since 1945, the reasons for crises and how the world responds to them have changed every 10-15 years or sooner.[27] These crises vary greatly across regions.[28] The economic, environmental, ecological, social, and disease crises are increasingly under the influence of widely integrated global changes and forces that are more often slow-moving, but increasingly severe and massive in that they affect larger populations across many borders. These slow-moving crises are unseen yet subtle, powerful and encompassing, where public health infrastructures and protections become overwhelmed over time with the emergence of increasing population-based, preventable health emergencies related to water, sanitation, food, shelter, energy, and related health illnesses, not casualties of war. Health impacts are often characterized by four major categories: weather-related morbidity and mortality, waterborne diseases/water-related illness, vector-borne and zoonotic diseases, and psychiatric/mental health effects.[29]

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP; Bangkok, Thailand) 2016 Report on the Economics of Climate Change emphasizes that the region is the most natural-disaster-prone with almost one-half of the number of the world's disasters.[30] The Global Risks Perceptions Survey (GRRPS) "underpins the views of risk experts globally," suggesting that the three prominent risk concerns are: (1) that climate change extreme weather events and natural catastrophes will result in "disproportionate consequences across the region," especially because of the wide disparities in the socio-economic status of individual countries; (2) that "failures in national governance" with links to "economic struggles, social unrest, and terrorism" remain high-risks to the region; and (3) that regional propensity for infectious diseases must be controlled. In 2003, the severe acute respiratory syndrome (SARS) startled an unprepared region spreading rapidly from China to 37 other countries before it was finally controlled by internationally driven public health interventions. Although China improved their public health capacity and capabilities, the region still endures greater risk with over 70 new or re-emerging diseases discovered each decade, primarily within China and South East Asia, ensuring that infectious diseases will remain the second most leading cause of death in the region.[31–33]

Risks will continue unchanged as long as the density of populations increase, live animal markets proliferate, bacterial spreading remains unchallenged in increasingly warming oceans, easy and unmonitored travel of people and goods occur across borders, malnutrition and maternal mortality are ignored, government spending on public health remains low and not focused on those who need it the most, and that environmental and societal norms crucial to prevention and control have not been met, let alone the serious economic consequences another pandemic would cause.[34] In 2017, ESCAP emphasized that an increasing risk of natural disasters within the Region are out-pacing resilience capacity and "could push the most disaster-prone areas into poverty unless action is taken."[35]

The 2018 GRRPS reveals that all environmental threats have grown in prominence, ranking higher than average for both likelihood and impact over the next decade. This report follows a year characterized by high-impact hurricanes, extreme temperatures, and the first rise in CO2 emissions for four years.[36] The report acknowledged that disasters are exacerbated by "risk multipliers," specifically "climate change, population growth and urbanization, and environmental degradation," in combination with poverty, poor governance, and a degraded infrastructure. The usage of the term "infrastructure" in similar reports is primarily focused on economic failures, investment shortfalls, or upgrades needed to energy, transportation, and communications. While medical and public health infrastructure is not specifically referred to, reports have emphasized failure of urban planning from "poorly planned cities, urban sprawl, and associated infrastructure that create social, environmental, and health challenges" and a "significant decline in the available quality and quantity of fresh water, resulting in harmful effects on human health and/or economic activity," biodiversity being lost at mass-extinction rates, and agricultural systems under strain from pollution of the air and sea as pressing threats to human health.[36]

Most crucial, especially in this region, is a trend towards nation-state unilateralism, in conflict with those who see critical answers to these problems only emanating from a more globalized world thinking and concerted efforts across national borders. Collective global direction to solve both regional and globally driven crises are sourly lacking and seemingly declining, making it more difficult to sustain the long-term, multilateral responses that are required to

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

counter global warming and the degradation of the global environment. Asia leadership must learn from Africa, where one-half of Madagascar's population has been under severe drought with loss of their maize/corn crop, having to sell off their starving animals, while surviving on seeds and wild cactus fruit, all of which drive local disease dynamics.[37,38] Clinically, this results in slow-onset starvation because of the lack of food, a dire health condition unlike micronutrient based malnutrition illnesses (eg, scurvy from lack of vitamin C, or blindness from vitamin A deficiency) that was the mainstay of the humanitarian community's relief efforts in Africa related to decades-long war and armed conflicts of the 20th century. Unlearned or forgotten food-base strategies, frequently over-looked in the past, require new ideas and approaches on a massive scale by governments, the donor community, the international agencies, and researchers. If attention is given immediately to uncovering the causes of indirect mortality and morbidity, then preparedness and prevention works.

Shared Risks to the Region

The concept of global public health is ubiquitous and pervasive and too often only observed and discussed at the 30,000-meter-level. It doesn't tell us how issues practically translate day to day. The region's diversity is unique with countries at all stages of development, capacity, and capability to respond, but less capacity to prevent, prepare, or recover. Being home to the majority of the global poor, the developing countries of the region are unable to survive or participate in adapting, depending entirely on the developed world's planning and response that too often has proven to be inadequate.[28]

To make sense of the issues facing us, we need to discuss them through some semblance of a framework that includes the major global public health issues facing all countries, not just Asia and the Pacific. To clarify the interpretation of multidisciplinary risk factors common to the current crisis and their management, this report uses a Venn diagram (Figure 1), a thinking tool, to illustrate the overlapping and shared relationships between forces, both natural and human-made, that represent already established or emerging public health emergencies and their unique propensity for conflict generation. Global public health crises have increasingly focused attention on four frames: climate extremes, rapid urbanization, essential scarcities, and biodiversity losses, evident in defining the cruciality of the course of any conflict, rather than a single infectious disease for example, which arises out of disturbances in biodiversity.

There is much overlap and mutual dependency that is expected in slow-moving crises such as droughts, floods, sea level rises, desertification, salinization, ocean acidification, and glacial retreats. Adams suggests that society always avoids studying these slow-moving global disasters "because we rise to the challenge even when it seems impossible."[39] Initially, crises at the community-level are "discreet and unique" to that community, allowing the community to anticipate, assess, and manage its individual characteristics and risks based on predictable cultural expressions.[40] The ugly elephant in the room that all four frames have in common is their inherent capacity to contribute to the risk, onset, duration, outcome, and nature of community-level or regional conflict as public health protections disappear. They may be symptomatic of a larger and growing public health problem because no solutions are readily forthcoming resulting, for some, to move away in mass to find a better or safer location within or across borders. For the most part, the major crisis drivers and their multipliers defined here are symptomatic of the entire Asia-Pacific region.

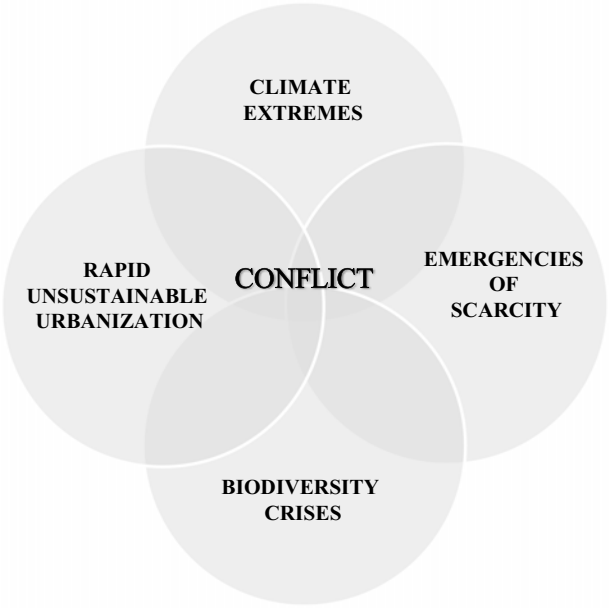

Figure 1. Major Drivers of Crisis Driven Public Health Emergencies Impacting Asia and the Pacific Region and Risks for Conflict.

Climate Extremes

Climate change itself is a normal and dynamic force that has been occurring since the beginning of time; however, not, as many expert scientists believe, at the rapid rate we see today or the extremes of its presentation or risk to the global community. Those forces are clearly human-made and referred to as global "climate extremes," or the on-going symptom of accelerated and more powerful climate-based events. Of those recorded in the region, 90% occur in China, India, Philippines, and Indonesia as weather-related (floods, storms, heat waves, droughts, or fires) accounting for over 20 million refugees. The leading concerns in the region list droughts or water shortages at 41%, severe weather (floods or intense storms) at 34%, long periods of unusually hot weather at 13%, and rising sea levels at six percent.[41] Taken separately, the Pacific island population sees rising sea levels and water shortages as their greatest concerns.[42]

With rising global mean temperatures, more intense typhoons and tropical cyclones are expected to repeatedly hit the region. Annual precipitation is expected to increase by up to 50%. Floods cause the highest death rates and the greatest economic losses, with 58 million people affected by floods, droughts, and storms in China alone. Forty-eight percent of flood deaths occur in Asia, accounting for 85% of those killed and 86% affected globally.[43] With increasing warming of the ocean, the intensity of each typhoon is greater and the season is longer. Mainland China, Taiwan, Korea, and Japan are likely to experience increasing damage from typhoons. Increased vulnerability will significantly impact the global economically with flood losses expected to increase from the $6 billion in 2005 to $52 billion per year by 2050. Moreover, 13 of the top 20 cities with the largest growth of annual flood losses from 2005-2050 are in Asia and the Pacific: Guangzhou, Shenzhen, Tianjin, Zhanjiang, and Xiamen (PRC); Mumbai, Chennai-Madras, Surat, and Kolkata (India); Ho Chi Minh City (Viet Nam); Jakarta (Indonesia); Bangkok

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

(Thailand); and Nagoya (Japan).[44] A comprehensive assessment of current and future risks to the region warns that within coastal and low-lying areas of "19 of the 25 cities most exposed to a one-meter sea-level rise are located within the region, seven of which are in the Philippines alone." Indonesia "will be the most affected country by coastal flooding" with "approximately 5.9 million people expected to be affected every year until 2100."[45] If mitigation and adaptation efforts are not quickly and strongly implemented, the Asian Development Bank (ADB; Metro Manila, Philippines) warns that unabated warming could largely diminish previous achievements of economic development. Indeed, many countries in the region, such as small island states, least developing countries, and landlocked developing countries, face even more severe challenges to address inclusive development, poverty, and infrastructure needs and create new ones.[46]

While much of the world still focuses on the response phase alone, crisis planners must shift their focus to the entire disaster cycle: anticipation, assessment, prevention, preparedness, response, recovery, and rehabilitation. Encouragingly, prevention and preparation have been the educational and operational focus of the Association of SouthEast Asian Nations (ASEAN; Jakarta, Indonesia) adopting the premise that "for each dollar spent on disaster preparedness, an average of four dollars is saved on disaster response and recovery."[27,47,48]

Both land and ocean temperatures have been rising. The National Oceanic and Atmospheric Administration (NOAA; Silver Spring, Maryland USA) percentiles in 2013 received particular attention because of unexpected global temperature rises. There were two versions of NOAA's report published in 2016, the first showed what was the anticipated temperature rises,[49] only to be replaced three months later by an unscheduled and disquieting revision that revealed more severe rises than what was expected, with an added warning that "global warming will be quicker and more catastrophic than previously envisioned."[50] Without major improvements, a six-degree Celsius temperature increase is projected over the Asian landmass by the end of the century. Some countries in the region such as Tajikistan, Afghanistan, Pakistan, and the northwest part of the People's Republic of China are projected to experience an eight-degree Celsius rise. The ADB ominously declares that "These increases in temperature would lead to drastic changes in the region's weather system, agriculture and fisheries sectors, land and marine biodiversity, domestic and regional security, trade, urban development, migration, and health which may crush any hope of achieving sustainable and inclusive development."[46] In addition, heat-related deaths in the region among the elderly are expected to increase by approximately 52,000 cases by 2050, as will deaths related to vector-borne diseases such as malaria and dengue.[45]

Drought, the "common thread" for major crises world-wide, is secondary to the loss of ground water normally replenished by centuries-old deep aquifers that are over-extended, or simply no longer exist. Epidemiologically, the severity can be measured by the severe loss of maize, soy, rice, and wheat crops that the drought has produced in every region of the world. Droughts destroy crops, kill animals, and dry up water sources resulting in damaged food and cash crop production, higher inflation, increased poverty, weaker exports, and political instability.[51] China's Yangtze and Yellow River beds have dried and impacted to a degree that it is likened to cement during prolonged droughts; when the rains return, the water is not absorbed, but works as a major conduit for floods for the surrounding cities.

Despite the United Nation's drought early warning initiative, the 2017 drought that hit Northern China was the worst on record with Chinese officials reemphasizing that conditions were "turning grim because of the prolonged lack of rainfall,"[52] insisting that countries abide by the Paris climate accord[53] that includes public and private investments focused on the rapid decarbonization of the Asian economy.[44] Improved irrigation systems, water management, agricultural practices, disaster preparedness, and regional sharing of scarce water have, in part, been successful. Drought management "demonstrates the interconnectedness demands" of the region, reemphasizing that "ignoring El Nino is not an option for countries in Asia."[54]

Climate Extremes and Conflict

In 2017, Burkle highlighted the conflict in Syria to underscore public health global lessons that must not be forgotten; and with the chronic ethnic and cultural animosities worsening within Asia, Middle Eastern conflicts serve as foreboding reminders.[55] The current war in Syria, from 2011 to 2016, began with 60% of Syria's agricultural northeast and south suffering its worst drought, water shortage, and crop failure, compounded further by failures in governance and management of the Assad regime.[56] With previous droughts, the Assad regime provided relief despite the population's religious differences. With oil prices dropping, the Assad regime claimed it was unable to respond as it had in the past. Poverty accelerated the exodus of farmers, herders, and rural families to cities in the west fomenting the first conflict and then today's major sectarian war.[55] In retrospect, multiple public health interventions were available and could have ceased or mitigated the population exodus.[57] Similar lost opportunities for preventive engagement with droughts occurred in the Sudan, Somalia, Eritrea, and Ethiopia, all leading to migration of large numbers of the affected populations. If all the forcibly displaced persons would be placed in one state, it would be the 21st largest populated country in the world.[58] Populations escaping from public health collapse as internally displaced or refugees have exceeded those from warfare alone, further burdening the already fragile public health protections in host countries such as Jordan, Lebanon, Turkey, and Greece.[55] Is this a similar fate for the Asia-Pacific?

In 2013, scientists began to debate whether there were legitimate connections between the development of violence and climate-related factors and those who prefer to explain conflicts simply as social processes.[59,60] By 2015, policy experts found the public more motivated to mitigate climate change when it is framed as a health issue. Improved medical understanding of the association between climate change and conflict could strengthen mitigation efforts and increase cooperation to cope with the climate change that is today considered inevitable. Other analysts likened climate change with a heightened risk of conflict and diminishing resource availability to explain the increased frequency of civil conflict in developing countries, terrorism, asymmetric warfare, state failure, and major regional conflicts, especially in ethnically fractionalized countries.[61] The medical understanding of these threats is inadequate, given the scale of health implications.

In 2015, Bowles and colleagues found that the "disruptive nature of these events seems to play out in ethnically fractionalized societies in a particularly tragic way in leading to conflict."[62] Where the literature diverges is in the relative importance of climate and migration as drivers of conflict, compared to other factors.[63] Canyon and colleagues, in forecasting the impact of climate change on infectious disease, recommend a community resilience model

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

rather than that of a specific communicable disease, adding that local information is a prerequisite for strategic and tactical planning.[64] Time and resources are required to analyze risks within each community and to anticipate and assess any threatening events. Specific requirements must emphasize community roles by focusing on how best to maintain, respond, and recover public health protections and the infrastructure necessary for health security.[65] Burkle emphasized that health professionals can no longer stay silent and pander to the ignorance of others, challenging them, along with multidisciplinary partners and stakeholders, to define a strong collaborative and cooperative stance on climate change.[66,67] Both Burrows and Kinney, and Schwartz, in exploring the potential pathways linking climate change, migration, and increased risk of violence, feel the migration issues could have been handled differently, and that it is unrealistic to expect that a general theory will emerge that can predict where climate-related migration and conflict is likely to occur or what will trigger or increase the risk of conflict.[63,68]

Rapid Unsustainable Urbanization

How extensive is rapid unsustainable urbanization? One answer, despite a globe with very diffuse and unequal destinations such as seen in Asia and the Pacific, is that in Mumbai, the financial capital of India, over one-half of the population live in slums.[69] In comparison, the urban poor in Africa referred to at times as being urban disamenities, a term that denotes the very unpleasant and insulting quality of their person being studied, ranging from 35% to 50%. Where urban slums exist, African cities are home to the highest world-wide child and maternal mortality and morbidity rates, where more than one billion people have no political voice, where too commonly public health resources are in steady decline, sanitation ignored, infectious diseases more prevalent, and extreme poverty is maintained or worsened, and where the population may be forced to pay for the use of one latrine per 150-200 people, which is over a 10 minute walk and unsafe for women to use at night.[70] Humanitarian assistance in Africa has moved from rural to urban areas, resulting in the largest disparity between the "have and have not" populations since 1950's Alma Ata. In all regions of the world, the humanitarian community is not prepared to protect the urban public health infrastructure or system across the entire disaster cycle, not just response and recovery.

Compared to Africa where the urban migration has led to increased violence, in Asia, migrant populations have settled onto the only available land, with "many informal settlements located in fragile environmental areas on shorelines and major river basins." Much of the unsettled land is available because it is historically prone to natural disasters. In 2017, the degree of urbanization world-wide was 54% with Asia at 49% and the Pacific Islands at 69%.[71] All of the Pacific Islands are essentially urbanized, suffering worsening non-communicable and communicable diseases. No island has experienced as rapid a public health decline and chronic infectious diseases as the Marshall Island of Ebeye, which may be the most densely populated island in the Pacific and one of the top five most population-dense places globally with over 15,000 people living on 0.36sq km coral atoll.[72] Kiribati, with a population of 100,000, rapidly rising sea water levels, and the mixing of sparse freshwater resources and sewage, suffers chronic diarrhea, pneumonia, and the highest infant mortality rate in the Pacific.[73]

The urbanization rate in the Asia and Pacific region grew faster this past decade than that of the United States and the European Union combined, where 13 of 31 mega-cities of more than 10 million inhabitants exist. Of the world's 47 fastest growing cities, six are in Africa and 40 in Asia, 20 of which are in China.[74] The 2013 ESCAP factsheet on urbanization trends in the region warns that urban growth in the region is "not environmentally sustainable." While sustained urbanization was possible at one time, the resource-base sustaining the human population is now in steady decline, primarily due to the "poor quality of air, clean water supply, and management of waste and sanitation."[75] Overall, East Asia's population density grew to more than 1.5-times the average for the world's urban areas and more than 50-times the average density in the United States.[76,77] The urban population in 2010 numbered 754 million people, more than the combined population of the United States and the European Union.[78]

China's Pearl River Delta Urban Development Project, encompassing nine cities and 42 million people, the total size of which is equal to that of the states of Vermont and New Jersey combined, making it the largest urban area in the world based on size and population. It has the goal to improve governance of public health infrastructure, especially wastewater management and transportation.[79,80] Cities with a massive replacement of farmland by concrete and asphalt have sustained increases in temperature and spoiled water from their natural routes. All of these cities produce their own climates.

For the first time, the 2015 World Bank (Washington, DC USA) Report compared urban areas and their populations in a "consistent manner across 350 urban areas in East Asia." The study revealed that despite a huge wave of urbanization in the first decade of this century, the process has the potential for "more decades of urban growth to come." While the continued growth of Asia's emerging middle class and the "direct link between urbanization and income growth," the region is still home to the world's largest urban slum population and largest concentration of people living below the poverty line.[81]

Crucial to Asia's successful rapid urbanization is that it must improve and maintain public safety. In its 2017 Safe Cities Index, which analyses four categories: digital security, healthy security, infrastructure security, and personal security, the Economist Intelligence Unit (London, United Kingdom) found that wealthy global capitals are "creating cities with previously unimagined population sizes" that are also plagued with extreme weather from climate change and other natural forces posing new and greater urban risks. No city is immune. The report is crucial, reminding all in crisis management how critical success is dependent on an urban center's ability to think and practice across professions. The report emphasized that "Businesses in fast-growing markets have a clear economic interest in a safe city, populated with contented consumers untroubled by cybercrime, and healthy and productive workers breathing clean air in green open spaces."[82] Fenson adds: "With Asia's urbanization set to continue, the economic and commercial imperative to improve its cities has never been greater."[76]

Earthquake-prone Tokyo, which once again tops the overall rating in safety, showed the "strongest performance in digital safety and health security," but has fallen in infrastructure security. Maintaining infrastructure credibility is expensive. Affluence drives infrastructure security with other cities in the region: Singapore, Wellington, Hong Kong, Melbourne, and Sydney among the best in infrastructure safety. Lowest on the list are low-income cities that have "failed to upgrade old infrastructure" such as Mumbai, Delhi, Manila, Yangon, Karachi, and Dhaka.[82]

In developing countries, the rapid expansion of urban populations is also putting pressure on infrastructure, particularly as young people leave rural areas and head for the city. Inequalities within cities are persistent and widespread as urban poor continue to lack access to adequate shelter, water, sanitation, health, sufficient incomes, and even a legally defined address. With most of the world now calling a city their home,[82] poor and disadvantaged communities have been and will continue to be disproportionately affected with the UN calling this "the dark side of economic growth;" "current economic models are not providing a sufficient basis for inclusive and sustainable development."[83]

Rapid Unsustainable Urbanization and Conflict

The number of armed conflicts and wars has declined significantly since the end of the Cold War, especially the number of large-scale, high-casualty conflicts.[84] Low-intensity conflict such as protests or riots, or more organized political upheaval and internal armed conflict, are common. Urdal contends that East and Southeast Asia have avoided conflict stemming from large youth populations by providing education and employment opportunities. Yet, with most rural-to-urban migrants being youth, there are many unknowns as to what explains urban violence and must monitor these trends closely to see what the population factors mean.[85] Conflict is most often related to the ills provoked less by population numbers and more by increased population density and inequality, an opinion for the most part that is being ignored, especially in places like India. Others disagree stating that population composition, not population density, is associated with political conflict.[86] The Population Institute (Washington, DC USA) claims that "brisk population growth can quickly lead to over-population and instability in poor countries with stressed resources." Rapid urbanization becomes unsustainable when the population density increases beyond the capacity of public health infrastructure and social protections, especially if stability is undermined by taxing available space and resources.[87]

East Asia's population density grew to more than 1.5-times the average for the world's urban areas and more than 50-times the average density in the United States.[76] However, despite the rise of the mega-cities, two-thirds of the region's urban areas are comprised of 100,000 to 500,000 people, with the biggest growth in urban population occurring in medium-sized areas. Asia has nonetheless seen income inequality rising by more than 20%, a growth pattern that cannot be considered inclusive. Caution prevails by those who suggest that development and urbanization "will likely increase rather than decrease violence in the coming decade." With almost 350 urban areas spilling over local administrative boundaries, rapid urbanization has increased metropolitan fragmentation, reduced security of land tenure, and provoked a rise of inequality and regional disparities that have intensified subnational conflicts in Thailand, the Philippines, Cambodia, India, and Mongolia.[88] Not only will urban land area triple globally before 2030, the projected expansion will take place on some of the world's most productive croplands.[89] Multiple factors can converge to dispossess people from their land, induce conflicts, and increase migration from rural areas. The degrading land productivity, deepening impacts of changes in climate, conflict, and food insecurity; poverty; and lack of livelihood opportunities are driving mostly the rural poor into towns and cities.[90] Many city-dwellers in Asia, and in India specifically, are men, 65% below the age of 35, who migrate alone, have limited time, relying increasingly on street foods, poor shelter, lack of sanitation, and hygiene in slums. Family and community support, which was woven into the rural social fabric, is now lacking. With rapid urbanization, under-nutrition and micronutrient deficiencies are rampant with one in three stunted under-five children out of 155 million globally now living urban areas.

Close to 90% of urban population and area growth is forecast in Asia and Africa, with the most dramatic changes foreseen in Asia.[91] China's uneven progress against poverty suggests that while migration to urban areas has helped reduce poverty nationally, the bulk of the reduction in poverty came from rural areas; it will be more difficult for China to maintain its past rate of progress against poverty without addressing the problems of continually rising inequality, a major factor in controlling conflict.[92]

Evans, admitting that the current knowledge-base of urbanization is limited, argues that to understand, control, and reduce armed conflict in urban centers in the future requires an urban-oriented understanding of the ecology of cities.[93] Unfortunately, where population densities range from 30,000 to one million people per square kilometer, those who migrate to urban centers for employment will rarely expect to accomplish what they hoped for. Also, one cannot deny that an abrupt climate extreme could disrupt functioning ecosystem services, prompting mass migration, mostly to urban areas that could suddenly make cities more crowded and overwhelm available social and health services.[94] Groesbeck and others stress that effect of conflict on urbanization is an important question that needs more study, especially in developing countries where conflict is more prevalent.[94,95]

Biodiversity Crises

Biodiversity areas are key to global survival as they contain the majority of the world's plants and vertebrates that are the foundation of human and ecosystem survival. Globally, 35 "biodiversity hotspots" or "centers of diversity" exist as areas with high levels of species diversity and represent the most important sites for biodiversity conservation world-wide. They are identified globally and nationally using global standardized criteria and thresholds. A hotspot must meet two strict criteria:[96]

1. It must have at least 1,500 vascular plants as endemics containing a high percentage of plant life found nowhere else on the planet. A hotspot, in other words, is irreplaceable. And,
2. It must have 30% or less of its original natural vegetation. In other words, it must be threatened as a hotspot.

They provide food diversity; fresh water; maintain social fertility; pollinate crops; balance species of bacteria, viruses, and other organisms; provide raw materials and fuel; and regulate climate and air quality. High biodiversity is the world's major safeguard against infectious diseases.[96]

Biodiversity "hotspots" occur when there is a loss of at least 70% of its original, most biologically diverse and threatened habitat. Hotspots cover just 2.3% of the planet's surface. For centuries, invaders have fought to occupy highly biodiverse areas identified by outsiders as having advantages such as more abundance of food, water, health, and other resources. Indeed, human population expansion has increased 71% in areas of highest biodiversity.[50,96] Over 90% of major armed conflicts between 1950-2000 occurred in 28 of 35 biodiversity areas threatening hotspots to occur. More than 80% of these took place in the hotspot areas themselves.

War poses a major challenge to the conservation community where biodiversity must be recovered quickly post-conflict to avert a major disaster. "Warfare ecologists" have been deployed to work in combat zones to strengthen environmental protection before, during, and after conflicts, and to assist governments to defuse incipient conflicts,

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

resolve those underway, and to reduce their toll on people and nature. Encouragingly, military planners now consider climate change a "threat multiplier" affecting national security and post-war rehabilitation of ecosystem services. Political scientists have argued that resource conflicts fought over oil, water, arable land, food supplies, and more risk being an increasing cause of modern interstate warfare.[97] The South China Sea's Spratly Islands, all biodiverse hotspots, support over 600 coral species and 6,000 fish species now under threat of extinction because the island chain is home to 15 military bases.[98] Other consequences of disregard for the environmental sanctity of these areas result in air, water, and soil pollution.[99] Research increasingly tells us that the essential diversity of nature cannot support the current pressure that humanity is placing on the planet resulting in a biodiversity loss 1,000-times the natural rate.[100] This occurs because of the extinction of individual species, over-exploitation of flora and fauna, habitat destruction, land conversion for agriculture and development, climate change, rise in temperature, pollution, and the spread of invasive alien species. Increases in temperature have caused drastic changes in Asia and the Pacific's weather system, agriculture and fisheries sectors, land and marine biodiversity, domestic and regional security, trade, urban development, migration, and health, and they risk crushing any hope of achieving sustainable and inclusive development.[101] Globally, more than 150,000 protected areas have been designated with a goal of protecting species and ecosystems, but whether they can continue to achieve this goal as human impacts escalate is unknown. Unfortunately, researchers have shown in South Asia that the current pace of the establishment of new, protected areas will not be able to overcome current trends of loss of marine and terrestrial biodiversity.[102]

The International Union for Conservation of Nature's (IUCN; Geneva, Switzerland) comprehensive Red List covering thousands of plant and animal species and sub-species claims over-exploitation and agriculture activity are the most prevalent threats facing these vulnerable species, followed by urban development, invasive species disease, both natural and introduction of new genetic material, pollution, systems modification (ie, fire, dams, and others), and climate extremes (ie, storms, floods, habitat modification, extreme temperatures, and drought). Most worrisome is that despite attempts to provide protected areas for marine and land-based species, the diversity trend continues to decline. The human footprint is wide-spread and rapidly increasing in these biodiverse areas with seven percent of global ecosystems showing marked increases in population use.[50] Sixty percent of groundwater supporting 750 million people in Pakistan, India, Nepal, and Bangladesh is NOT drinkable or usable for irrigation, a severe hit to economies and health.[103]

Marine ecosystems, particularly in the Western Pacific, will be in serious danger by 2100. All coral reef systems in the sub-region will collapse due to mass coral bleaching if global warming increases by four-degrees Celsius (global business-as-usual scenario). Even with a 1.5-degree Celsius temperature increase, 89% of coral reefs are expected to suffer from serious bleaching, severely affecting reef-related fisheries and tourism in Southeast Asia.[44,104,105] The *Living Planet Report* documents the state of the planet, including biodiversity, ecosystems, and demand on natural resources, and what this means for humans and wildlife, especially in the areas of poaching, habitat destruction, climate change, and human-wildlife conflict. The population sizes of vertebrate species, mammals, birds, reptiles, amphibians, and fish, have declined by 58% in less than two human generations.[106,107] The facts and figures in the report paint a challenging picture, yet claim plenty of room for optimism. Several countries have managed to raise the standards of living for their populations while using resources at much less intensity than industrial countries. In 2015, the 2030 Sustainable Development Goals were adopted along with the Paris climate agreement to accelerate and intensify the actions and investments needed for a sustainable low-carbon future, a better understanding of the scale of human impact on the planet, and the way the key environmental systems interact and manage them.[106,107]

Biodiversity Crises and Conflict

Looking at the major forces that impact conflict, authors acknowledge the social concerns that accompany biodiversity conservation arguing that sometimes we must support conservation for biodiversity's sake, not for its direct human benefits.[108] As conservation conflicts increase, there is need to minimize the negative aspects on biodiversity and human livelihoods and well-being with clear goals and a transparent evidence-base.[109] Despite the remarkably consistent pattern of armed conflict in biodiversity hotspots with most hotspots suffering repeated episodes of violence, evidence suggests that in politically volatile regions, "biodiversity conservation is improved when international nongovernmental organizations maintain continuous involvement, support and protect local staff throughout the conflict, and incorporate activities into military, reconstruction, and humanitarian programs."[110] McNeely and colleagues have identified progress with key policy issues that have improved regional cooperation among relevant stakeholders.[111]

Asia faces numerous and unique biodiversity challenges with the protection of freshwater biodiversity topping the conservation priority list. Freshwater makes up only "0.01% of the world's water and only 0.8% of the earth's surface." Declines in freshwater biodiversity are far greater than those in the most affected terrestrial ecosystems. If trends in "human demands for water remain unaltered and species losses continue at current rates, the opportunity to conserve much of the remaining biodiversity in fresh water will vanish, demanding immediate adoption of a new paradigm for biodiversity protection and freshwater ecosystem management."[112]

McMichael, aware of the dominate human-microbe transitions that have been accelerated by the four frames being discussed, asserts that "a new equilibrial state may lie ahead." Any mature, sustainable, human ecology must come to terms with both the need for, and the needs of, the microbial species that help to make up the interdependent system of life on Earth. However, it certainly will not entail a world free of infectious diseases. Whereas humans and microbes are not "at war," they represent a crucially important microbial level conflict where both are engaged in a moral, self-interested, co-evolutionary struggle. We need to understand better, and therefore anticipate, the dynamics of that process.[113] While there are many environmental and behavioral determinants of disease, climate change and extremes can serve as the initial insult altering land use, destroying its inherent protections, and resulting in health impacts. Patz and colleagues implore clinicians to "develop stronger ties, not only to public health officials and scientists, but also to earth and environmental scientists and policymakers. Without such efforts, we will inevitably benefit our current generation at the cost of generations to come."[114]

Other scientists stress that wartime epidemics of infectious diseases have decimated the fighting strength of armies, caused the suspension and cancellation of military operations, and brought havoc to the civil populations of belligerent and nonbelligerent states.[115] Again, numerous authors have focused on the current war in Syria and the emergence of the high prevalence of multi-

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

drug-resistant infections, both in war wounds and among refugees from the Syrian war and Jordan, which risk being spread globally.[116] This represents the first incident where all antibiotics have proven resistant, with some researchers worried this may spell the beginning of the end of antibiotic use as we know it. Antimicrobial resistance, because of the loss of biodiversity protections, is already a major health problem world-wide with marked variations in the resistance profiles of bacterial pathogens found between countries and in different patient settings, especially in Asia.[117] Overcoming antimicrobial resistance requires global collective action, biodiversity, and sustainability.[50,118]

Mora and Sale argue that global diversity loss needs to go beyond protected areas. There is an "overall failure to protect against the broad range of threats affecting existing ecosystems," claiming any progress to date has been negatively impacted by "budget constraints, conflicts with human development, and a growing human population that will increase not only the extent of anthropogenic stressors, but the difficulty in successfully enforcing protected areas." There is a "clear and urgent" need for additional solutions that "stabilize the size of the world's population and our ecological demands on biodiversity loss."[103]

Emergencies of Scarcity

Of all the natural resources, water, food, and energy are highly interconnected as a resource and policy nexus that is most needed to sustain life on Earth. Their insecurity is an impediment to both social stability and economic growth, especially in China where growing shortages of water and the security of food and energy resources threaten China's development.[119] Per capita water availability is the lowest in the world. In Asia, the fastest increase in water loss comes not from agriculture but rather demands from industry and urban households requiring expanding amounts of energy. Food security is tenuous with over 20% of the undernourished populations living in South and South-West Asia. This water-food-energy nexus requires many water and energy policies that today are largely in isolation from one another.[120] Again, we are reminded of Africa where slow-onset starvation occurs with lack of food, not just micronutrient based malnutrition.[121] Crucial for much of the Asia Pacific populace occurred in 2015 with over a 35% drop in catches of fish, their main protein staple, because of high CO2 emissions.[122,123]

With the turn of the century, climate extremes and scarcity of energy, water, and food was re-defining China's public health status. By 2011, 43% of state-monitored rivers were so polluted that they were unsuitable for human contact, and the downstream microorganism ecology from major rivers had been altered by chemicals and fertilizers dumped by industry and cities, resulting in new and reemerging diseases.[124] More than one-quarter of the country's rivers, lakes, and streams were too contaminated to be used for drinking water. Acid rain, it added, has become a problem in nearly 200 of the 440 cities it monitored.[125] A 2010 NATURE study cautioned that with 22% of the world's population and only seven percent of the world's arable land, they questioned China's water resources and agriculture future and ability to feed its people, especially as soil erosion greatly exceeds rates of production.[126] Nitrogen produced by fossil fuel and geological reservoirs of other fertilizers are headed toward possible scarcity, increased cost, and/or geopolitical conflict, with the added insult that climate change is accelerating the microbial release of greenhouse gases from soil organic matter and will likely play a larger role in the climate future, as will increases in the frequencies of droughts and floods in some areas of China.[127,128]

Mekonnen and Hoekstra claim that fresh water scarcity is worsening and soon will be an all-year-round crisis, resulting in two-thirds of the global population, one-half of them living in India and China,[129] and over-shadowing the effect of climate change on levels of water stress, resulting in more densely populated watersheds by 2050.[130] Gruber's Massachusetts Institute of Technology (MIT; Cambridge, Massachusetts USA) study points to "a perfect storm of economic growth, climate change, and demands of fast growing populations by 2050 leading to billions of people having access to a lot less water than they have today."[131] This will be especially scarce in northern China, where water scarcity can result in complete desiccation during dry seasons, decimation of aquatic biodiversity, and substantial economic disruption.[132] Even traditional age/gender-specific mortality and morbidity rates have lost some credibility when the entire population is equally vulnerable to these scarcities. Water scarcity exacerbated by El Nino's warming ocean temperatures have impacted populations from the Pacific island chain, especially the Marshall Islands, to Indonesia, and western China with Asian countries the hardest hit resulting in energy, food, and water insecurity.[133]

The most polluting industries in China are agriculture, chemicals, and textiles. In 2016, 19.4% of arable farmland in China had polluted levels higher than the national average, and 16.1% of China's surveyed land is polluted by heavy metals like cadmium, arsenic, lead, and mercury. Overall environmental quality has again declined, questioning "is this the end of China's chemical love with nowhere to hide?" and prompting "triage plans of air, water, and soil to tackle pollution." Indeed, China agrees that there would have to be a slowdown in GDP growth to tackle its environmental issues, but President Xi has made no mention of changing in any specific targets. However, his plan for the future is "all about prioritizing great protections" over "great development," but little has been accomplished. Arsenic poisoning of drinking water is a major problem for China, and the threat it poses to global health much more wide-spread than previously believed.[134,135] Higher arsenic levels have been found in natural aquifers that serve as a supply of water in dozens of countries on all five continents with nations in South and East Asia accounting for over one-half of all cases of arsenic poisoning.[136]

In some countries of Southeast Asia, rice yields could decline by up to 50% by 2100 if no adaptation efforts are made.[44] Almost all crops in Uzbekistan, meanwhile, are projected to decrease by 20%-50% by 2050, even in a two-degree Celsius temperature increase. Food shortages could increase the number of malnourished children in South Asia by seven million.[44] Promising, China has identified evidence-based techniques and pooling of scientific data on local conditions and agricultural needs to make smallholder farmers more sufficient.[137] The Carbon Disclosure Project's (CDP; London, United Kingdom) 2017 Global Water Report shows a 193% increase in businesses leading the way on water stewardship. A water-secure world is possible, and the transition is underway. But to deliver it, water must be recognized as a fundamental asset for all companies and cities across the globe.[138]

Emergencies of Scarcity and Conflict

The Transatlantic Academy (Washington, DC USA) identified five resources: land, energy, food, water, and minerals as essential for human security. If "Unchecked in terms of international trade, they may set off international conflict."[139] Conflicts within countries have

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

dominated the region since 1990, with more than 120,000 water-related disputes in China alone. Water management efforts and resources in India often focus on "conflict management" between different states. The allocation of increasingly scarce water resources, however, is the principal cause of water conflicts. Direct conflict most commonly arises at the local level, and is often based on the construction of an "ill-thought-out" dam, ambiguous water withdrawal rights, water disputes over inter-basin water transfers, deteriorating water quality, and competing demands for water for urban, industrial, agriculture, and ecosystems upon which livelihoods depend.[140]

Busby's 2017 Discussion paper on water security reveals that a number of states experiencing conflict affected by water scarcity also have weak governance and are more common where watersheds are shared across borders; this reminds us that "while violence is not inevitable, conflicts are likely to become more severe where there are increased demands for water, growing urbanization, climate change, and changes in rainfall patterns and shifts in the geographic range of disease vectors such as mosquitoes." In Asia, both droughts and on-going contentions upstream dam building by China on the Mekong River have caused chronic security friction.[141]

Resource availability must be seen not as a stand-alone issue, but as integral to the overall political economy landscape.[142] Resource competition can become increasingly "aggressive" and referred to as "distributional conflicts" leading to population displacement.[143] Developing countries unable to survive or participate in adapting will depend entirely on the Developed world, plans of which have proven to be inadequate.[144] As the population of Asia expands, the competition for natural resources, particularly water, will intensify. Farmers and food producers will be competing with other users, including industry, cities, and the environment.[145]

Whereas Chinese cities have successfully outsourced their water treatment to large private companies, residents now have to pay a significant amount of money for water that in the past was free or nearly free, intensify the conflicts among different water users.[146] To avoid conflicts between the competing water users, researchers have given more emphasis on developing tools and techniques for sustainable water resources management to support reservoir operators and managers in optimizing water allocation, which is commonly referred to as "water grabbing."[147,148] Others stress that there is strong evidence that water scarcity contributes to conflict between pastoralists and farmers and indigenous migrants.[149]

Soil erosion greatly exceeds rates of production in many agricultural regions of Asia and the Pacific. Nitrogen produced by fossil fuel and geological reservoirs of other fertilizers are headed toward possible scarcity, increased cost, and/or geopolitical conflict. Moreover, a warmer climate for the region could endanger energy supply. Climate change can exacerbate energy insecurity through continued reliance on unsustainable fossil fuels, reduced capacities of thermal power plants due to a scarcity of cooling water, and intermittent performance of hydropower plants as a result of uncertain water discharges, among other factors. Energy insecurity could lead to conflicts as countries compete for limited energy supply.[44]

A climate change security workshop in Japan in 2016 defined factors that increase state fragility, social unrest, and potentially violent conflict, citing that the Asia-Pacific already has the highest number of active conflicts and sub-national conflicts, which climate change is exacerbating. This being said, the region must guard against any exacerbation of resource competition, conflict among fisheries, and migration and refugees from increasingly fragile regional small island states leading to political unrest. They look to establishing long-term resilience partnerships between G7 and countries starting with a systematic and deeper risk assessment on how fragility and conflict will play out in the region.[150]

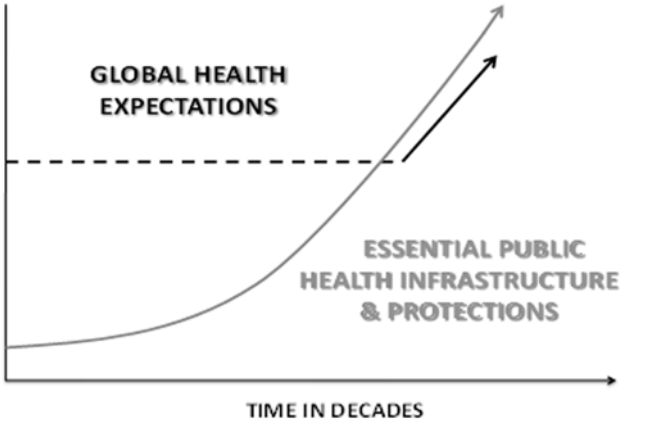

Figure 2. Illustration that Global Health Expectations, Primarily Economically Driven, Will Never be Realized, Unless Essential Public Health Infrastructure and Protections are Accomplished. Global public health serves as the foundation of what all countries eventually aspire to in defining global health.

Few in the West are aware that more demonstrations against policies and social unrest occur in China than any other country. The lessons learned by the Communist Party from Tiananmen Square was to allow the over 180,000 protests, riots, and mass demonstrations that average over 500 per day (the highest of any country) to occur. Demonstrations that arise from governmental exploitation of land, local policy dissent, and challenges to labor movements are actually supported by the Communist Party. The citizenry is allowed to demonstrate by expressing their anger over several days, always short of attacking security forces, and then receive some financial compensation for their losses. But what is never allowed is advocating for democratic change, which would lead to prison. They must dutifully keep dissent both "within-system and small scale," never revolutionary in nature or publicly critical of the Communist Party. But writers question whether these tight restrictions will remain if the economy falters, or because basic public health protections become more blaringly absent?[151,152]

Discussion and Conclusions

As we begin efforts to curtail these existing and potential dire consequences, we need to take heed of the words of the late Richard Levins, PhD, a famed public health scholar who wrote:

> . . . surprises are inevitable in science . . . we found, for example, that pesticides increase pests, antibiotics can create pathogens, agricultural development creates hunger, and flood control leads to flooding . . . But some of these surprises could have been avoided if the problems had been posed big enough to accommodate solutions in the context of the whole.

The whole, it could be argued, operationally defines global public health.[153]

Figure 2 illustrates that global health expectations will never be realized unless essential public health infrastructure and protections are accomplished as, or before, the economic gains are fulfilled. The repair and updating of essential public health infrastructure and protections must come first or in concert with economic growth. Despite political promises, this has not been done. A good example

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

is China, who currently risks failure in their economic gains for this negligence. Unfortunately, as expressed by President Xi, China's reasoning for successes in "global health" is primarily economically driven by political and industrial promises that the health of nations and regions will automatically improve as the economy flourishes. This is not the case.

Ilona Kickbusch said it best when she reported that global challenges are deeply flawed by "rising political actors confronted with the consequences of a model of development that has not only neglected sustainability and equity, but was built on their exploitation."[154] Current models of expansion created great wealth as well as rising inequities in emerging economies, putting the health and survival of the people and the planet at-risk, including conflict and its many dire ramifications. For them, "global health" is an inspirational expectation of their economic promises. They have hijacked global health as "economic health," and unwisely the world of public health succumbed. Public Health **is** global health for the public good underlying social, economic, environmental, and political determinates.[155] These are functionally indistinguishable with the findings of the 2018 World Economic Forum in Davos, Switzerland that promotes an economic blueprint that transcends national borders, that is sustainable in a world where health needs have become more complex, and opportunities for coordinated prevention and treatment, both regionally and globally, are crucial to survival.[156]

One of very few studies to make a distinction between global health and global public health is that of Li and Kasai's "The Asia Pacific strategy for emerging disease: a strategy for regional health security," which acknowledges that "As the Region is home to more than 50% of the world population, true *global public health security* depends to a large degree upon how successful this Region is in developing and sustaining functional national and regional systems and capacities for managing emerging diseases and acute public health events and emergencies."[157] Because the nations least responsible for climate change are most vulnerable to its effects, the challenge to address each and every frame discussed in this report is not merely technical, but also moral.[158]

Using an ensemble of 62 climate scenarios, Lin and colleagues found that between 1991-2010 and 2081-2100, 96% of studied eco-regions, including South Asia, will be likely to face moderate-to-pronounced climate changes when compared to the magnitudes of change during the past five decades:[159]

> "The Asian countries hold Earth's future in their hands. If they choose to protect themselves against dangerous climate change, they will help to save the entire planet." "The challenge is twofold. One, Asian greenhouse-gas emissions have to be reduced in a way that the global community can limit planetary warming to well below two degrees Celsius, as agreed to in Paris in 2015. Even adapting to 1.5-degrees Celsius temperature rise is a major task. Secondly, Asian countries have to find strategies for ensuring prosperity and security under unavoidable climate change within a healthy global development. Leading the clean industrial revolution will provide Asia with unprecedented economic opportunities, and exploring the best strategies to absorb the shocks of environmental change will make Asia a crucial actor in 21st-century multilateralism."[44]

> "Getting urban form, density, and administrative coordination right will be essential to help end extreme poverty and boost shared prosperity," said Abhas Jha, the Practice Manager for the World Bank Group Social, Urban, Rural, and Resilience Global Practice.[160]

Not forgetting our Pacific Island neighbors, Reaves and colleagues further recommend a community-centric approach for Oceania that would better assist island nations in reducing disaster risk throughout the traditional disaster management cycle, defining a potential and crucial role military assets and resources as a more meaningful partner in disaster risk reduction and community capacity building. With most island nations experiencing "acute-on-chronic" environmental stresses (acute disaster events on top of the consequences of climate change) in all Pacific Island nation-states and territories, the authors warn that the symptoms of this process are seen in both short- and long-term health concerns and a deteriorating public health infrastructure. These factors tend to build on each other.[161]

The United Nations Convention to Combat Desertification in 2017 starkly reminds us that "Land is an essential building block of civilization, yet its contribution to our quality of life is perceived and valued in starkly different and often incompatible ways. A minority has grown rich from the unsustainable use and large-scale exploitation of land resources with related conflicts intensifying in many countries. The world has reached a point where we must reconcile these differences and rethink the way in which we plan, use, and manage the land."[162] Most worrisome is the current World Bank report that people fleeing climate change's impacts on the land may number over 140 million by 2050.[163]

When it comes to health-driven conflicts, the nations at-risk are NOT prepared to protect the urban public health infrastructure or handle emergencies of scarcity. Future crises will either be prevented or solved by global public health initiatives, not by individual nation-states. Globally, vital and sustainable public health infrastructures and protections are rapidly disappearing. Currently, our major public health challenge is that soil and water biodiversity can be maintained and partially restored only if managed sustainably backed by multidisciplinary and transdisciplinary research (such as public health and its social and political aspects) and actions that no one nation-state or health system can solve alone. A massive shift from response to prevention and preparedness must occur to meet the demands for better coordination and control, which is heard after every international crisis. The roles of developed countries are increasingly complex, confusing, politically charged, and risky. China's ability to mobilize fellow G-20 members into collective action has been exceptional, a model that hopefully can be brought to global public health. With the demand for global coordination and collaboration, the China-Harvard-Africa Network (CHAN; Boston, Massachusetts USA) is but one example that serves as a platform for convening scholars, experts, and policy leaders from Africa, China, and the United States to address issues of common interest; for conducting collaborative research; and for nurturing future generations of public health scholars, researchers, and leaders. Can CHAN be duplicated for the Asia-Pacific? Encouragingly, the countries who rate the highest in multidisciplinary research, much of which is essential to global public health, are India and Mainland China.[164]

Meyer reminds us that it is false that better scientific information leads to better outcomes among political decision makers. Politicians the world over listen to economists, not to scientists. The benefits of research are modest because solving societal problems are difficult and complicated. The most powerful confirmation of that claim is that for the United States, there has been and continues to be NO prospect of moving climate change legislation through Congress, the body that represents the people. Might interest be stirred if conflict risk data were added?[165]

Lastly, Nisbet, in a series of studies examining how Americans respond to climate change when the issues are

https://doi.org/10.1017/S1049023X19004953 Published online by Cambridge University Press

reframed as a public health problem is disappointing. Results suggest that strategies on climate change that involve an emphasis on public health will require sustained, well-resourced, and highly coordinated activities in which such messages are repeated and emphasized by a diversity of trusted messengers and opinion leaders, ones that are "localized and tailored to specific regions."[166] The usual economy versus the environment debate must include "public health." First, public health must inform communities that the public's health is already being harmed by climate change and the magnitude of its harm is certain to get worse. Second, climate change public engagement efforts have focused primarily on the environmental dimensions of the threat. Public health community holds the potential to engage a broader range of the population. Thirdly, actions that slow or prevent climate change and protect human health from the harms associated with climate change also benefits health and well-being in ways unrelated to climate change, a "win-win" to society as a whole.[167,168]

References

1. The World Bank. Results profile: China poverty reduction. March 19, 2010. http://www.worldbank.org/en/news/feature/2010/03/19/results-profile-china-poverty-reduction. Accessed July 2019.
2. Carey M. Ecological problems in China. *The UNEDITED*. October 7, 2000. http://www.theunedited.com/econauts/18.html. Accessed July 2019.
3. Xinhua. 2016-08-20. *Editor Huaxia*. http://www.xinhuanet.com/english/2016-08/20/c_135618492.htm. Accessed July 2019.
4. Wike R, Stokes B. Chinese Public Sees More Powerful Role in World, Names US as Top Threat. *Pew Research Center*. October 5, 2016. https://www.pewresearch.org/global/2016/10/05/chinese-public-sees-more-powerful-role-in-world-names-u-s-as-top-threat/. Accessed July 2019.
5. Asia Development Bank. Health Issues in Asia and the Pacific. https://www.adb.org/sectors/health/issues. Accessed July 2019.
6. Uretsky E, Bouey J, Katz R. China's emerging role in global health. *Health Affairs Blog*. January 17, 2013. https://www.healthaffairs.org/do/10.1377/hblog20180109.759800/full/. Accessed July 2019.
7. Koplan JP, Bond TC, Merson MH, et al. Consortium of Universities for Global Health Executive Board. Towards a common definition of global health. *Lancet*. 2009;373(9679):1993–1995.
8. Battams S, Matlin S. Discussing a definition of global health: policy brief. Graduate Institute of International and Development Studies; Geneva, Switzerland. December 2013. https://www.researchgate.net/publication/259196481_Discussing_a_definition_of_global_health_Policy_Brief. Accessed July 2019.
9. Rodriguez JM, Bound J, Geronimus AT. US infant mortality and the President's party. *Int J Epidemiol*. 2014;43(3):818–826.
10. Homan P. Political gender inequality and infant mortality in the United States, 1990-2012. *Soc Sci Med*. 2017;182:127–135.
11. Kawachi I, Kennedy BP, Gupta V, Prothrow-Stith D. Women's status and the health of women and men: a view from the States. *Soc Sci Med*. 1999;48(1):21–32.
12. Burkle FM Jr, Greenough PG. Impact of public health emergencies on modern disaster taxonomy, planning, and response. *Disaster Med Public Health Prep*. 2008;2(3):192–199.
13. Osler W. *Aequanimitas. Unity, Peace, and Concord*. 3rd Edition. New York USA: McGraw-Hill Book Company, Inc.; 1906:429–430.
14. Toole MJ. Mass population displacement. A global public health challenge. *Infect Dis Clin North Am*. 1995;9(2):353–366.
15. Public Health and War. History of Medicine Collections. US National Library of Medicine. Bethesda, Maryland USA. August 18, 2014. https://www.nlm.nih.gov/hmd/digicolls/phfgtw/essay.html. Accessed July 2019.
16. Ghobarah HA, Huth P, Russett B. The post-war public health effects of civil conflict. *Soc Sci Med*. 2004;59(4):869–884.
17. Foggia M. Reconstruction Successes and Failures. October 18, 2012. https://prezi.com/5kh3qsju4kwm/reconstruction-successes-and-failures/. Accessed July 2019.
18. Robles F, Davis K, Fink S, Almukhtar S. Official Toll in Puerto Rico: 64. Actual deaths May be 1,052. December 9, 2017. *New York Times*. https://www.nytimes.com/interactive/2017/12/08/us/puerto-rico-hurricane-maria-death-toll.html. Accessed July 2019.
19. Burkle FM Jr. Zika: Defining the public health and exposing its deficiencies. https://www.researchgate.net/publication/297698775_ZikaDefining_the_public_health_and_exposings_its_deficienecies. Accessed July 2019.
20. Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I). Enacted 1977-06-08, Geneva, Switzerland. http://www.jus.uio.no/english/services/library/treaties/05/5-01/protection-of-victims.xml. Accessed July 2019.
21. Burkle F Jr, Garfield R. Civilian mortality after the 2003 invasion of Iraq. *Lancet*. 2013;381(9870):877–879.
22. Lacina B, Gleditsch NP. Monitoring trends in global conflict: a new dataset of battle deaths. *European Journal of Population*. 2005;21(2-3):145–166.
23. OCHA. World Humanitarian Data and trends 2016. Policy Analysis and Innovation Section, Policy Development and Studies Branch. https://data.humdata.org/dataset/world-humanitarian-data-and-trends. Accessed July 2019.
24. Scholz N. The public health dimension of the European migrant crisis. Members Research Service. PE573.908. European Parliamentary Research Service. *Briefing*. January 2016. http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573908/EPRS_BRI(2016)573908_EN.pdf. Accessed July 2019.
25. Bradby H, Humphris R, Newall D, Phillimore J. Public health aspects of migrant health: a review of the evidence on health status for refugees and asylum seekers in the European Region. Health Evidence Network Synthesis Report 44. WHO, National Office for Europe. http://www.euro.who.int/__data/assets/pdf_file/0004/289246/WHO-HEN-Report-A5-2-Refugees_FINAL.pdf. Accessed July 2019.
26. WHO. Health of Migrants. Report by the Secretariat. Executive Board, 122nd Session provisional agenda item 4.8. EB122/11. December 20, 2007. http://www.who.int/hac/techguidance/health_of_migrants/B122_11-en.pdf. Accessed July 2019.
27. Burkle FM, Martone G, Greenough PG. The changing face of humanitarian crises. *Brown Journal of World Affairs*. Spring/Summer 2014;XX(11):25–42.
28. Gursky EA, Burkle FM Jr, Hamon DW, Walker P, Benjamin GC. The changing face of crises and aid in the Asia-Pacific. *Biosecur Bioterror*. 2014;12(6):310–317.
29. Veenema TG, Thornton CP, Lavin RP, et al. Climate change-related water disasters' impact on population health. *J Nurs Scholarsh*. 2017;49(6):625–634.
30. The Economics of Climate Change in the Asia-Pacific Region. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) 2016. www.unescap.org/resources/economics-climate-change-asia-pacific-region. Accessed July 2019.
31. The Global Risks Report 2016, 11th Edition. World Economic Forum. Geneva, Switzerland. http://wef.ch/risks2016. Accessed July 2019.
32. Burkle FM Jr. The limits to our capacity: reflections on resiliency, community engagement, and recovery in 21st-century crises. *Disaster Med Public Health Prep*. 2011;5(Suppl 2):S176–181.
33. Burkle FM Jr. Do pandemic preparedness planning systems ignore critical community- and local-level operational challenges? *Disaster Med Public Health Prep*. 2010;4(1):24–29.
34. Evolving Risk Concerns in Asia-Pacific: Building resilience in an Increasingly Uncertain Global Risk Environment. Asia Pacific Risk Center, Marsh & McLennan Companies, Inc. 2016. www.mmc.com/asia-pacific-risk-center.html. Accessed July 2019.
35. Pratt N. UN issues disaster risk warning for Asia-Pacific. *Commercial Risk: Insurance & Risk Management News*. October 11, 2017. http://www.commercialriskonline.com/un-issues-disaster-risk-warning-asia-pacific/. Accessed July 2019.
36. The Global Risks Report 2018. 13th Edition World Economic Forum. Geneva, Switzerland. http://www3.weforum.org/docs/WEF_GRR18_Report.pdf. Accessed July 2019.
37. Ingram JC, Dawson TP. Climate change impacts and vegetation response on the island of Madagascar. *Philos Trans A Math Phys Eng Sci*. 2005;363(1826):55–59.
38. Kreppel KS, Caminade C, Telfer S, et al. A non-stationary relationship between global climate phenomena and human plague incidence in Madagascar. *PLoS Negl Trop Dis*. 2014;8(10):e3155.
39. Scott Adams' Blog. Adams Law of slow-moving disasters-update. Posted January 22, 2015. http://blog.dilbert.com/2015/01/22/adams-law-of-slow-moving-disasters-update/. Accessed July 2019.
40. Rodgers P. Development of resilient Australia: enhancing the PPRR approach with anticipation, assessment and registration of risks. *Aus J Emerg Manag*. 2011;17(2):10–13.
41. Stokes B, Wike R, Carle J. Concern about climate change and its consequences. Pew Research Center. November 5, 2015. http://www.pewglobal.org/2015/11/05/1-concern-about-climate-change-and-its-consequences/. Accessed July 2019.
42. 23rd Smaller Island States Leaders. Opening Statement by Secretary General Tuiloma Neroni Slade. 23rd Smaller Island States Leaders Meeting, Palau Community College Koro, Republic of Palau; July 28, 2014. http://www.forumsec.org/pages.cfm/newsroom/speeches/2014-3/opening-statement-at-23rd-smaller-island-states-leaders-meeting-by-secretary-general-tuiloma-neroni-slade.html. Accessed July 2019.
43. Weixiao H, Chen L, Baofa J, et al. Major natural disasters in China, 1985-2014: occurrence and damages. *J Environ Res Public Health*. 2016;13(11):1118.

44. Science News. Unabated climate change would reverse the development gains in Asia, report suggests. Potsdam Institute for Climate Impact Research. *Science Daily*. July 14, 2017. https://www.sciencedaily.com/releases/2017/07/170714140300.htm. Accessed July 2019.
45. Asian Development Bank. Unabated Climate Change Would Reverse the Hard-Earned Development Gains in Asia. *New Report News Release*. Manila, Philippines; July 14, 2017.
46. Asian Development Bank. A Region at Risk: The Human Dimensions of Climate Change in Asia and the Pacific. July 2017. https://www.adb.org/publications/region-at-risk-climate-change. Accessed July 2019.
47. Monguzzi A. Disasters preparedness saves lives and saves money. IFRC Europe Zone Office. April 9, 2013. http://www.ifrc.org/fr/nouvelles/nouvelles/common/disasters-preparedness-saves-lives-and-saves-money-61204/. Accessed July 2019.
48. UNICEF. Preparedness for Emergency Response in UNICEF. *Guidance Note EMOPS*. UNICEF: New York; December 2016. https://www.unicef.org/emergencies/files/UNICEF_Preparedness_Guidance_Note_29_Dec__2016_.pdf. Accessed July 2019.
49. Wallace T. Oceans are absorbing almost all of the globe's excess energy. September 12, 2016. https://www.nytimes.com/interactive/2016/09/12/science/earth/ocean-warming-climate-change.html. Accessed July 2019.
50. Laffoley D, Baxter JM, (eds). Explaining Ocean Warming: causes, scale, effects and consequences. Full report. Gland, Switzerland: ICUN. International Union for Conservation of Nature and Natural Resources, Global Marine and Polar Program. September 2016. http://www.epoca-project.eu/~gattuso/files/Magnan_Gattuso_2016.pdf. Accessed July 2019.
51. Tang A. El Nino parches Asia Pacific, destroying crops and drying up water sources. *Environment*. Thomson Reuters Foundation, January 26, 2016. https://www.reuters.com/article/us-asiapac-elnino-drought/el-nio-parches-asia-pacific-destroying-crops-and-drying-up-water-sources-idUSKCN0V41KE. Accessed July 2019.
52. Wong E. Drought in Northern China is worst on record, officials say. *Asia Pacific*. 2017. https://www.nytimes.com/2017/06/29/world/asia/china-drought.html. Accessed July 2019.
53. UNESCAP. UN initiative strengthens drought monitoring and early warning in Asia Pacific. *Eco-Business*. July 1, 2014. http://www.eco-business.com/news/un-initiative-strengthens-drought-monitoring-and-early-warning-asia-pacific/. Accessed July 2019.
54. El Nino, Poor water management, and climate change bringing droughts to Asia and the Pacific. June 14, 2016. *Asian Development Bank News and Events*. https://www.adb.org/news/features/el-nino-poor-water-management-and-climate-change-bringing-droughts-asia-and-pacific. Accessed July 2019.
55. Burkle FM Jr. The Politics of Global Public Health in Fragile States and Ungoverned Territories. *PLoS Curr*. 2017;9.
56. Greenwood S. Water insecurity, climate change, and governance in the Arab world. *Middle East Policy*. 2014;11:140–156.
57. Femia F, Werrell C. Syria: climate change, drought and social unrest. The Center for Climate and Security. https://climateandsecurity.org/2012/02/29/syria-climate-change-drought-and-social-unrest/. Accessed July 2019.
58. Global Trends: Forced Displacement in 2015. UNHCR, The UN Refugee Agency; Geneva, Switzerland. http://www.unhcr.org/statistics. Accessed July 2019.
59. Brzoska M, Scheffran J. Climate and war: no clear-cut schism. *Nature*. 2013;498(7453):171.
60. Solow AR. Global warming: a call for peace on climate and conflict. *Nature*. 2013;497(7448):179–180.
61. Schleussner CF, Donges JF, Donner RV, Schellnhuber HJ. Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries. *Proc Natl Acad Sci USA*. 2016;113(33):9216–9221.
62. Bowles DC, Butler CD, Morisetti N. Climate change, conflict and health. *J R Soc Med*. 2015;108(10):390–395.
63. Burrows K, Kinney PL. Exploring the climate change, migration and conflict nexus. *Int J Environ Res Public Health*. 2016;13(4);443.
64. Canyon DV, Speare R, Burkle FM. Forecasted impact of climate change on infectious disease and health security in Hawaii by 2050. *Disaster Med Public Health Prep*. 2016;10(6):797–804.
65. Canyon DV, Burkle FM, Speare R. Managing community resilience to climate extremes, rapid unsustainable urbanization, emergencies of scarcity, and biodiversity crises by use of a disaster risk reduction bank. *Disaster Med Public Health Prep*. 2015;9(6):619–624.
66. Burkle FM Jr. Pandering to ignorance on climate change: lessons from an investment strategist. *Prehosp Disaster Med*. 2013;28(3):200–201.
67. Burkle FM Jr. Future humanitarian crises: challenges for practice, policy, and public health. *Prehosp Disaster Med*. 2010;25(3):191–199.
68. Schwartz SA. War, climate change, and migration. *Explore*. 2018;14(3):172–176.
69. Taniaalim. Mumbai: Slums and Sanitation. October 23, 2017. https://citynessblog.wordpress.com/2017/10/23/mumbai-slums-and-sanitation/. Accessed July 2019.
70. Kwiringira J, Atekyereza P, Niwagaba C, Günther I. Gender variations in access, choice to use and cleaning of shared latrines; experiences from Kampala Slums, Uganda. *BMC Public Health*. 2014;14:1180.
71. The Statistics Portal. Degree of urbanization by continent in 2017. https://www.statista.com/statistics/270860/urbanization-by-continent/. Accessed July 2019.
72. Turcanin. Marshall Islands: Where America shot Mother Earth down. https://turcanin.wordpress.com/2012/05/25/marshall-islands-where-america-shot-mother-earth-down/. Accessed July 2019.
73. Kiribati Development Plan 2016-19 Government of Kiribati. http://www.mfed.gov.ki/sites/default/files/Kiribati%20Development%20Plan%202016%20-%2019.pdf. Accessed July 2019.
74. Yakupitiyage T. Urbanization May Be "Biggest Challenge" for Asia-Pacific. *Inter Press Service News Agency*. October 19, 2015. http://www.ipsnews.net/2015/10/urbanisation-may-be-biggest-challenge-for-asia-pacific-new-report-says/. Accessed July 2019.
75. ESCAP-UN Factsheet. Urbanization Trends in Asia and the Pacific. November 2013. http://www.unescap.org/resources/urbanization-trends-asia-and-pacific. Accessed July 2019.
76. Fenson A. Asia's Urbanization "just beginning." *The Diplomat: Know the Asia-Pacific*. January 30, 2015. https://thediplomat.com/2015/01/asias-urbanization-just-beginning/. Accessed July 2019.
77. ESCAP. United Nations Economic and Social Commission for Asia and the Pacific. Media Advisory; October 13, 2015: Bangkok. http://www.unescap.org/news/sixth-asia-pacific-urban-forum. Accessed July 2019.
78. ESCAP. UN Habitat. The State of Asian Cities 2010/11. August 9, 2010. https://issuu.com/unhabitat/docs/the_state_of_asian_cities. Accessed July 2019.
79. CUHK Business School: China's Pearl River Delta Development: A game Changer for Hong Kong. April 12, 2017. http://www.bschool.cuhk.edu.hk/faculty/cbk/article.aspx?id=34404834. Accessed July 2019.
80. The World Bank. Guangdong Pearl River Delta Urban Environment Project. *TWB: Projects & Operations*. 2018. The World Bank Group. http://projects.worldbank.org/P075728/guangdong-pearl-river-delta-urban-environment-project?lang=en&tab=details. Accessed July 2019.
81. SmartCities Council. Getting urbanization right: New World Bank report on East Asia points the way. February 4, 2015. https://smartcitiescouncil.com/article/getting-urbanization-right-new-world-bank-report-east-asia-points-way. Accessed July 2019.
82. Safe Cities Index 2017. Security in a rapidly urbanizing world. Economist Intelligence Unit. *The Economist*. http://safecities.economist.com/safe-cities-index-2017. Accessed July 2019.
83. Yakupitiyage T. Urbanization May Be "Biggest Challenge" for Asia-Pacific, New Report Says. *Inter Press Service*. March 11, 2018. http://www.ipsnews.net/2015/10/urbanisation-may-be-biggest-challenge-for-asia-pacific-new-report-says/. Accessed July 2019.
84. Human Security Report Project and World Bank. *Mini-Atlas of Human Security*. New York USA: Simon Fraser University; 2008.
85. Urdal H. A clash or generations? Youth bulges and political violence. September 11, 2006; 50(3):607-629. http://onlinelibrary.wiley.com/doi/10.1111/j.1468-2478.2006.00416.x/abstract. Accessed July 2019.
86. Thayer Bradley A. Considering population and war: a critical and neglected aspect of conflict studies. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2009;364(1532):3081–3092.
87. Population Institute. Overpopulation may lead to conflict. July 12, 2007. https://www.populationinstitute.org/newsroom/press/view/20/. Accessed July 2019.
88. The State of Conflict and Violence in Asia. The Asia Foundation. San Francisco, California USA. 2017. https://asiafoundation.org/wp-content/uploads/2017/10/The_State_of_Conflict_and_Violence_in_Asia-12.29.17.pdf. Accessed July 2019.
89. Manipadma J. The Urbanization of Malnutrition. *Inter Press Service*. March 4, 2018. http://www.ipsnews.net/2017/09/the-urbanization-of-malnutrition/. Accessed July 2019.
90. The World Bank. World Bank Report Provides New Data to Help Ensure Urban Growth Benefits the Poor. January 26, 2015. http://www.worldbank.org/en/news/press-release/2015/01/26/world-bank-report-provides-new-data-to-help-ensure-urban-growth-benefits-the-poor. Accessed July 2019.
91. United Nations. Global Land Outlook Report. Convention to Combat Desertification. Secretariat of the United Nations Convention to Combat Desertification. Platz der Vereinten Nationen 1,53113. Bonn, Germany. 2017. http://archive.unccd.int/download/GLO_Full_Report_hi_res.pdf. Accessed July 2019.
92. Ravallion M, Chen S. China's (uneven) progress against poverty. *Journal of Development Economics*. 2007;82:1–42. http://siteresources.worldbank.org/PGLP/Resources/ShaohuaPaper.pdf. Accessed July 2019.
93. Evans M. Future war in cities: urbanization's challenge to strategic studies in the 21st century. *International Review of the Red Cross*. 2016;98(1):37–51.
94. Campbell KM, Gulledge J, McNeill JR, et al. The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change. Center for Strategic and International Studies, Center for a New American

Security. November 2007. https://www.scribd.com/document/224353750/Climate-Change. Accessed July 2019.
95. Groesbeck J. Conflict and urbanization. April 25, 2013. https://prezi.com/ntoudo9iokyn/conflict-and-urbanization/. Accessed July 2019.
96. Reid A. War, human rights and biodiversity: turning conflict into conservation. *Ecologist*. March 23, 2017. https://theecologist.org/2017/mar/23/war-human-rights-and-biodiversity-turning-conflict-conservation. Accessed July 2019.
97. Machlis GE, Hanson T. Warfare Ecology. *BioScience*. 2008;58(8):729–736.
98. Asner G. Military bases and submarines: what it's like to dive in the South China Sea. March 29, 2017. https://www.cnn.com/2017/03/29/opinions/south-china-sea-coral-reef-destruction/index.html. Accessed July 2019.
99. McDonald AM, Bonsor HC, Ahmed KM, et al. Groundwater quality and depletion in the Indo-Gangetic Basin mapped from in situ observations. *Nature Geoscience*. 2016;9:762–766.
100. Shah A. Loss of biodiversity and extinctions. *Global Issues*. January 19, 2014. http://www.globalissues.org/article/171/loss-of-biodiversity-and-extinctions. Accessed July 2019.
101. ReliefWeb. A Region at Risk: The human dimensions of climate change in Asia and the Pacific. *Report from Asian Development Bank*. July 14, 2017. https://reliefweb.int/report/world/region-risk-human-dimensions-climate-change-asia-and-pacific. Accessed July 2019.
102. Clark NE, Boakes EH, McGowan PJK, Mace GM, Fuller RA. Protected areas in South Asia have not prevented habitat loss: a study using historical models of land-use change. *PLoS ONE*. 2013;8(5):e65298.
103. Mora C, Sale PF. Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. *Marine Ecology Progress Series*. 2011;434:251–266.
104. Wiens JJ. Climate-related local extinctions are already widespread among plant and animal species. *PLOS Biology*. 2016;14(12):e2001104.
105. Guam Daily Post. Report: Pacific Islanders face risk of relocation by end of century. *PacNews*. July 18, 2017. https://www.postguam.com/news/pacific/report-pacific-islanders-face-risk-of-relocation-by-end-of/article_50d22a64-6aaa-11e7-b897-37b317a99d72.html. Accessed July 2019.
106. Living Planet Report 2014. World Wildlife Fund: N.W. Washington, DC USA. https://www.worldwildlife.org/pages/living-planet-report-2014. Accessed July 2019.
107. Living Planet Report 2016. World Wildlife Fund: N.W. Washington, DC USA. https://www.wwf.org.uk/sites/default/files/2016-10/LPR_2016_summary_spread%20low%20res.pdf?_ga=2.237289417.873381499.1519854298-1117250747.1519854298. Accessed July 2019.
108. Chan KM, Pringle RM, Ranganathan J, et al. When agendas collide: human welfare and biological conservation. *Conserv Biol*. 2007;21(1):59–68.
109. Redpath SM, Young J, Evely A, et al. Understanding and managing conservation conflicts. *Trends Ecol Evol*. 2013;28(2):100–109.
110. Hanson T, Brooks TM, Da Fonseca GA, et al. Warfare in biodiversity hotspots. *Conserv Biol*. 2009;23(3):578–587.
111. McNeely JA, Kapoor-Vijay P, Zhi L, et al. Conservation biology in Asia: the major policy challenges. *Conserv Biol*. 2009;23(4):805–810.
112. Dudgeon D, Arthington AH, Gessner MO, et al. Freshwater biodiversity: importance, threats, status and conservation challenges. *Biol Rev Camb Philos Soc*. 2006;81(2):163–182.
113. McMichael AJ. Environmental and social influences on emerging infectious diseases: past, present and future. *Philos Trans R Soc Lond B Biol Sci*. 2004;359(1447):1049–1058.
114. Patz JA, Olson SH, Uejio CK, Gibbs HK. Disease emergence from global climate and land use change. *Med Clin North Am*. 2008;92(6):1473–1491, xii.
115. Smallman-Raynor MR, Cliff AD. Impact of infectious diseases on war. *Infect Dis Clin North Am*. 2004;18(2):341–368.
116. Teicher CL, Ronat JB, Fakhri RM, et al. Antimicrobial drug-resistant bacteria isolated from Syrian war-injured patients, August 2011-March 2013. *Emerg Infect Dis*. 2014;20(11):1949–1951.
117. Huang YT, Hsueh PR. Antimicrobial drug resistance in Taiwan. *Int J Antimicrob Agents*. 2008;32(Suppl 3):S174–178.
118. Syrians Contend with New Threat: The Rise of Antibiotic-Resistant Infections. *Newsweek*. September 14, 2016. http://www.newsweek.com/syrians-contend-new-threat-rise-antibiotic-resistant-infections-497713. Accessed July 2019.
119. Larson C. Growing shortages of water threaten china's development. July 16, 2010. *Yale Environment360*. https://e360.yale.edu/features/growing_shortages_of_water_threaten_chinas_development. Accessed July 2019.
120. ESCAP. The status of the water-food-energy nexus in Asia and the Pacific. August 1, 2013. http://www.unescap.org/resources/status-water-food-energy-nexus-asia-and-pacific. Accessed July 2019.
121. Müller O, Krawinkel M. Malnutrition and health in developing countries. *CMAJ*. 2005;173(3):279–286.
122. Lam VWY, Cheung WWL, Reygondeau G, Sumaila UR. Projected change in global fisheries revenues under climate change. *Scientific Reports*. 2016;6:32607.
123. Weatherdon LV, Ota Y, Jones MC, Close DA, Cheung WW. Projected scenarios for coastal first nations' fisheries catch potential under climate change: management challenges and opportunities. *PLoS One*. 2016;11(1).
124. Water Pollution in China: Facts and Details. 2010. http://factsanddetails.com/china/cat10/sub66/item391.html. Accessed July 2019.
125. Jacobs A. In China, pollution worsens despite new efforts. July 28, 2010. Asia Pacific. New York Times. http://www.nytimes.com/2010/07/29/world/asia/29china.html. Accessed July 2019.
126. Piao S, Ciais P, Huang Y, et al. The impacts of climate change on water resources and agriculture in China. *Nature*. 2010;467(7311):43–51.
127. Amundson R, Berhe AA, Hopmans JW, Olson C, Sztein AE, Sparks DL. Soil science. Soil and human security in the 21st century. *Science*. 2015;348(6235):1261071.
128. Tong S, Berry HL, Ebi K, et al. Climate change, food, water and population health in China. *Bull World Health Organ*. 2016;94(10):759–765.
129. Mekonnen MM, Hoekstra AY. Four billion people facing severe water scarcity. *Sci Adv*. 2016;2(2):e1500323.
130. Fant C, Schlosser CA, Gao X, et al. Projections of water stress based on an ensemble of socioeconomic growth and climate change scenarios: a case study in Asia. *PLoS ONE*. 2016;11(3):e0150633.
131. Gruber B. By 2050 Asia at high risk of severe water shortages: MIT study. *Environment*. April 14, 2016. https://www.reuters.com/article/us-asia-water-crisis-tracked/by-2050-asia-at-high-risk-of-severe-water-shortages-mit-study-idUSKCN0XB207). Accessed July 2019.
132. Hoekstra AY, Mekonnen MM, Chapagain AK, Mathews RE, Richter BD. Global monthly water scarcity: blue water footprints versus blue water availability. *PLoS ONE*. 2012;7(2):e32688.
133. Evans A. Managing Scarcity: The Institutional Dimensions. Global Dashboard. Global Policy Forum. August 25, 2009. https://www.globalpolicy.org/security-council/dark-side-of-natural-resources/other-articles-analysis-and-general-debate/48191.html. Accessed July 2019.
134. China Water Risk: Analysis & Reviews China's Soil. February 14, 2018. http://chinawaterrisk.org/resources/analysis-reviews/5-trends-for-2018-the-year-of-the-dog/. Accessed July 2019.
135. Mukherjee A, Sengupta MK, Hossain MA, et al. Arsenic contamination in groundwater: a global perspective with emphasis on the Asian scenario. *J Health Popul Nutr*. 2006;24(2):142–163.
136. Bagchi S. Arsenic threat reaching global dimensions. *CMAJ*. 2007;177(11):1344–1345.
137. Cui Z, Zhang H, Chen X, et al. Pursuing sustainable productivity with millions of smallholder farmers. *Nature*. 2018;55:363–366.
138. Carbon Disclosure Project. A Turning Tide. https://www.cdp.net/en/research/global-reports/global-water-report-2017. Accessed July 2019.
139. Andrews-Speed P, Bleischwitz R, Boersma T, et al. *The Global Resource Nexus. The Struggles for Land, Energy, Food, Water, and Minerals*. Washington, DC USA: Transatlantic Academy; 2012.
140. United Nations Department of Economic and Social Affairs. International Decade for Action: Water for Life: 2005-2015. http://www.un.org/waterforlifedecade/index.shtml. Accessed July 2019.
141. Busby J. Water and US National Security. January 2017. Council on Foreign Relations, Center for Preventive Action and Program on Energy Security and Climate Change. Maurice R. Greenberg Center for Geo-economic Studies.
142. Evans A. Resource scarcity, climate change and the risk of violent conflict. *World Development Report*. 2011; Background Paper: September 9, 2010.
143. Maiese M. "Causes of Disputes and Conflicts." In: Burgess G, Burgess H, (eds). *Beyond Intractability*. Boulder, Colorado USA: Conflict Research Consortium, University of Colorado, Boulder; October 2003. http://www.beyondintractability.org/essay/underlying-causes. Accessed July 2019.
144. Davey T. Developing countries can't afford climate change. August 5, 2016. *Future of Life Institute*. https://futureoflife.org/2016/08/05/developing-countries-cant-afford-climate-change/. Accessed July 2019.
145. Australia and FAO partner to improve agricultural water management and food security in Asia. May 12, 2017. http://www.fao.org/emergencies/fao-in-action/stories/stories-detail/en/c/1071606/. Accessed July 2019.
146. Water Pollution in China: Facts and Details. 2014. http://factsanddetails.com/china/cat10/sub66/item391.html. Accessed July 2019.
147. Ahmad I, Zhang F, Liu J, et al. A linear bi-level multi-objective program for optimal allocation of water resources. *PLoS ONE*. 2018;13(2):e0192294.
148. Breu T, Bader C, Messerli P, Heinimann A, Rist S, Eckert S. Large-scale land acquisition and its effects on the water balance in investor and host countries. *PLoS ONE*. 2016;11(3): e0150901.
149. United Nations Environment Program (UNDP). Livelihood Security: Climate change, Migration and Conflict in the Sahel. https://postconflict.unep.ch/publications/UNEP_Sahel_EN.pdf. Accessed July 2019.

150. Ruttinger L. Climate Diplomacy. Climate-fragility risks in Japan and the Asia-Pacific region. Workshop Documentation. June 14-16, 2016. Tokyo, Japan. https://www.google.com/search?q=japan+and+climaste+change+security+and+conflict&ie=utf-8&oe=utf-8&client=firefox-b-1. Accessed July 2019.
151. Fisher M. How China stays stable despite 500 protests every day. *The Atlantic*. January 5, 2012. https://www.theatlantic.com/international/archive/2012/01/how-china-stays-stable-despite-500-protests-every-day/250940/. Accessed April 1, 2018.
152. Hernandez JC. Labor protest multiply in China as economy slows, worrying leaders. Asia Pacific. *New York Times*. March 14, 2016. https://www.nytimes.com/2016/03/15/world/asia/china-labor-strike-protest.html. Accessed April 1, 2018.
153. Revolvy: Biography Richard Levins. https://www.revolvy.com/main/index.php?s=Richard%20Levins&item_type=topic. Accessed July 2019.
154. Kickbusch I. Global Health Governance Challenges 2016 - Are We Ready? *Int J Health Policy Manag*. 2016;5(6):349–353.
155. Beaglehole R, Bonita R. What is global health? *Global Health Action*. 2010;3:10.
156. World Economic Forum. What just happened? The biggest stories from Davos 2018. https://www.weforum.org/agenda/2018/01/davos-2018-biggest-stories/. Accessed July 2019.
157. Li A, Kasai T. The Asia Pacific Strategy for Emerging Diseases - a strategy for regional health security. *Western Pac Surveill Response J*. 2011;2(1):6–9.
158. Patz JA, Grabow ML, Limaye VS. When it rains, it pours: future climate extremes and health. *Ann Glob Health*. 2014;80(4):332–344.
159. Li J, Lin X, Chen A, et al. Global priority conservation areas in the face of 21st century climate change. *PLoS One*. 2013;8(1):e54839.
160. The World Bank. World Bank Report provides new data to help ensure urban growth benefits the poor. January 26, 2015. http://www.worldbank.org/en/news/press-release/2015/01/26/world-bank-report-provides-new-data-to-help-ensure-urban-growth-benefits-the-poor. Accessed July 2019.
161. Reaves EJ, Termini M, Burkle FM. Reshaping US Navy Pacific response in mitigating disaster risk in South Pacific Island nations: adopting community-based disaster cycle management. *Prehosp Disaster Med*. 2014;29(1):60–68.
162. Global Land Outlook: Key Messages. http://www2.unccd.int/sites/default/files/documents/2017-10/GLO%20KEY_ESUM-%20final-web.pdf. Accessed July 2019.
163. Kirby A. Climate refugees may reach many millions by 2050. *Climate News Network*. March 20, 2018. https://climatenewsnetwork.net/climate-refugees-may-reach-many-millions-by-2050/. Accessed July 2019.
164. Van Noorden R. Interdisciplinary research by the numbers. *Nature*. 2015;525;3017.
165. Meyer R. World View: Finding the true value of US climate science. *Nature*. February 9, 2012. https://www.nature.com/news/finding-the-true-value-of-us-climate-science-1.9993?nc=1419509956881. Accessed July 2019.
166. Nisbet M. Will the health dangers of climate change get people to care? The science says: maybe. *IFLScience*. April 7, 2016. https://www.iflscience.com/health-and-medicine/will-health-dangers-climate-change-get-people-care-science-says-maybe/. Accessed July 2019.
167. Weathers MR, Kendall BE. Developments in the framing of climate change as a public health issue in US newspapers. *Environmental Communication*. 2015;10(5):593–611.
168. Weathers M, Maibach EW, Nisbet MC. "*Climate Change and Health*." In: Thompson T, (ed). *Sage Encyclopedia of Health Communication*. Newbury Park, California USA: Sage Publications; 2014.