

Chapter 1

Climate Change and Geocology of South and Southeast Asia: An Introduction

Rais Akhtar

Abstract Climate change is projected to impact human health in many ways including changes in water availability and quality, air quality and sanitation, availability and access to food and nutrition and transmission of vector-borne diseases. Environmental consequences of climate change, such as extreme heat waves, rising sea levels, changes in precipitation resulting in flooding and droughts, intense hurricanes (cyclones, typhoons) and degraded air quality, can affect directly and indirectly the physical, social and psychological health of humans. Climate change and human health have emerged as an important focus of research in the World Health Organization since 2008. However, the First International Conference on Health and Climate organised by the WHO in August 2014 in Geneva recognises the relevance of the impact of climate change on human health from a global-change and health perspective. This chapter also highlights policies of the United States, China and India towards GHG emission reduction and the successful climate agreement in Paris in December 2015.

Keywords Vector-borne diseases • Katrina hurricane • GHG emissions • Heat wave • USA • China • India • Paris climate agreement

Climate change represents a range of environmental hazards and will affect populations wherever the current burden of climate-sensitive disease is high – such as the urban poor in low- and middle-income countries and landless farming communities. Understanding the current impact of weather and climate variability on the health of populations is the first step towards assessing the future impact.

Nevertheless climate change has been occurring and impacting human health and welfare across the globe – both in the developed and developing regions. Its impact was experienced mainly in the last one and a half decades. The 2003 heat wave in Western and Central Europe that killed nearly 70,000 people in 2 weeks time in the month of August, Hurricane Katrina disaster that devastated southern

R. Akhtar (✉)

International Institute of Health Management and Research (IIHMR), New Delhi, India
e-mail: raisakhtar@gmail.com

USA in 2005 and Hurricane Sandy in 2012; flooding and landslides in the United States and United Kingdom and bushfire in Australia and California in 2014 are examples which show that even developed countries are vulnerable to climate change impact (Akhtar 2014). It has also been predicted that the frequency of severe flooding across Europe will double by 2050 (Cannor 2014).

In the context of the United Kingdom, in a recent issue of *The Lancet Infectious Diseases* journal, scientists from the emergency response department of Public Health England suggest that mosquitoes and ticks are known to be highly responsive to changes in temperature and rainfall. Based on climate modelling, the report asserts that warmer temperatures in the United Kingdom in the future could provide ideal conditions for the Asian tiger mosquito (*Aedes albopictus*), which spreads the viruses that cause dengue and chikungunya. However, changes in vector distributions are being driven by climatic changes and changes in land use, infrastructure and environment (Medlock and Leach 2015).

We are aware about the scientific explanations that climate change occurs because excessive amount of greenhouse gases were emitted into the atmosphere due to human activity. Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. The Earth's atmosphere has already been warmed by 0.85 °C from 1880 to 2012. Recent climate changes have had widespread impact on human and natural systems (IPCC 2014).

In order to effectively address climate change, we must significantly reduce the amount of heat-trapping emissions we are putting into the atmosphere. We should therefore delve briefly into the policies towards reducing GHG emissions in the United States, China and India before the Paris Climate Agreement in December, 2015 was signed.

1.1 US Position

Contrary to President George W. Bush, the Obama Administration has focussed on the links between climate changes and human. This follows recent, salutary experiences including a variety of severe natural disasters, e.g., Hurricanes Katrina and Sandy, flooding, landslides, forest fires (in California) and drought. George Luber, head of the Climate and Health Programme of the US Centers for Disease Control and Prevention, has been central to this rising awareness in the United States. Luber claims that the climate change has extended the pollen season in some parts of the country by as much as 26 days, increasing the risk of allergy and asthma attacks. It has also contributed to heavier rainfalls, which can jeopardise drinking water quality. "Climate change isn't just about polar bears and penguins or impacts distant in time", Luber told *The Lancet*. He went on to explain that these impacts affect our communities and people's health, so "putting the human dimension on climate change is vital not only for understanding threat we face but also for encouraging action" (Jaffe 2015).

A study by Jonathan Patz and his colleagues that analysed data based on climate models and future projections reveals that "by 2050, many US cities may experi-

ence more frequent extreme hot days. For example New York and Milwaukee may have three times their current average number days hotter than 32 °C” (Patz et al. 2014).

1.2 Perspectives from India and China

Developing countries in general and India in particular face challenges to accelerate the pace of socioeconomic development and minimise inequalities, exacerbated during the colonial period. However, even after independence, inequalities in India have risen. India is in dire need of energy (per capita electricity consumption in India is 618 KW and in the United States 14,240) to enable infrastructure development. But there are also gross global inequalities. Most developing countries, including India, have the lowest per capita CO₂ emission (1.2 t per capita in India compared to 20.6 t in the United States), as well as the low gross domestic product (GDP) per capita. Despite this, major developed nations insist that developing nations reduce their greenhouse gas emissions, fundamental to their socioeconomic development. However, under the Kyoto Protocol, the principle of “common but differentiated responsibility” was considered as fundamental for future emission negotiations. This will promote equity and human development by expanding access to energy demand of developing countries (Akhtar 2010). India’s official thinking on climate change is derived from a policy advanced by Manmohan Singh, who served as the country’s prime minister until 2014. In 2007, he declared at a G20 summit in Germany that India’s per capita emissions will never exceed the average per capita emissions for developed countries. Right now, that gives India quite a bit of elbow room. If the United States and the European Union are able to attain the cuts they are now talking of, India’s leeway shrinks; though some in the Indian government believe that even then the country could continue to increase its emissions for 15 or 20 years beyond the 2030 cap China has agreed to and still fall below the developed world’s per capita average.

Emission cuts, at the moment, do not seem to be an Indian policy priority. But there is a new Prime Minister, Narendra Modi, and a new environmental minister, Prakash Javadekar. Is there a new emphasis? It would seem not, judging from a recent interview given to The New York Times after the September 2014 UN Climate Summit in New York: Prakash Javadekar said, “The moral principle of historic responsibility cannot be washed away” (Devenport 2014). This means that developed economies, chiefly the United States, which spent the last century building their economies while pumping warming emissions into the atmosphere, bear the greatest responsibility for cutting pollution. India’s Minister further clarified that government agencies in New Delhi were preparing plans for India’s domestic actions on climate change, but he said they would lead only to a lower rate of increase in carbon emissions. It would be at least 30 years, he said, before India would likely see a downturn.

1.3 China's Position

China's choking air pollution, including notorious smog levels in Beijing, has become a major problem in the country and poses a threat to Chinese public health. Coal combustion generates particulate matter also known as "PM". Currently Beijing is suffering from PM2.5. China now produces more pollutants than any other nation on earth, and 66 of the country's 74 largest cities still fall far short of the government's air quality standards (Larmer 2015).

Nevertheless, the Chinese government argued that the priorities of developing countries first and foremost are economic development and poverty reduction and that the international community should accommodate these growth needs. Officials have also often noted that although China is now the largest total emitter of GHG, it is not yet the largest in terms of historical cumulative emissions or per capita emissions (far from it in the latter case). After all, most developed countries undertook pollution-intensive industrialization during the nineteenth and twentieth centuries that resulted in large cumulative historical emissions (http://www.gov.cn/2011lh/content_1825838.htm).

Despite China's argument, its own domestic compulsions and international pressure are as follows: "the Chinese government proposed a carbon intensity reduction target for the first time in the 12th Five Year Plan. The attitude of Chinese policymakers toward climate change policy recently underwent a radical change, from having no explicit climate change policies to a Presidential commitment to reduce carbon intensity, need to control total energy consumption, and to gradually establish a carbon market. We posit that the motivation for this radical shift can be attributed to rising concerns about the projected impacts of climate change in China, and also the government's recognition that China's traditional development model is unsustainable, not only environmentally, but also from the standpoint of social and economic development. The Chinese central government has been searching for mechanisms to transform China's development trajectory, and climate change policy represents a new and justifiable tool that can help the government transform economic development in China, especially because climate policy can be used as a new central government instrument to guide and control the behaviour of local governments" (Xiaowei and Gallagher 2014).

Earlier in a secret negotiated climate deal, the United States and China unveiled a commitment to reduce their GHG output, with China agreeing to cap emissions for the first time and the United States committing to deep reductions by 2025. These pledges struck between US President Barack Obama and his Chinese counterpart, Xi Jinping, provide an important boost to international efforts to reach a global deal on reducing emissions beyond 2020 at the UN meeting in Paris this year. China, now the world's biggest GHG emitter, has agreed to cap its output by 2030. Previously China had only pledged to slow its rapid emission growth rate. Now it has also agreed to increase its use of energy from zero-emission sources to 20 % by 2030 (The Guardian 2014).

After having discussed the GHG emission policies of USA, China and India to combat climate change impacts, it is heartening to see the successful negotiations

reached at the Paris Climate Summit on 12th of December, 2015. According to the UNFCCC, the Paris Agreement aims to combat climate change and unleash actions and investment towards a low carbon, resilient and sustainable future was agreed by 195 nations. This Agreement “underwrites adequate support to developing nations and establishes a global goal to significantly strengthen adaptation to climate change through support and international cooperation. The Paris Agreement’s major objective is to keep a global temperature rise within 21st century well below 2 ° Celsius and to drive efforts to limit the temperature increase even further to 1.50 ° Celsius above pre-industrial levels.” <http://unfccc.int>

1.4 Climate Change and Human Health

Climate change and human health have emerged as an important focus of research in the World Health Organization since 2008. However, the First International Conference on Health and Climate organised by the WHO in August 2014 in Geneva pinpoints the relevance of the impact of climate change on human health from a global-change and health perspective (Neira 2014).

Climate change may affect health through a variety of pathways. These include the effects of an increased frequency and intensity of heat waves, a reduction in cold-related deaths, more frequent and more intense floods and droughts, changes in the distribution of vector-borne diseases and risk of disasters and malnutrition (Haines, 2014, Personal communication). In another study, Andy Haines and colleagues warned that the Representative Concentration Pathways (RCP 8.5) assume that present trends of relatively unrestrained use of fossil fuels and high population growth will continue. According to this emission pathway, by 2100 the global average temperature will probably be more than 4 °C above preindustrial levels with higher average temperatures over lands (Haines et al. 2014). The IPCC Fifth Assessment Report, the Chapter on Human Health, affirms with very high confidence that the health of human population is sensitive to shifts in weather patterns and other aspects of climate change. The Chapter also projects (1) greater risks of injury, disease and death due to more intense heat waves and fires (very high confidence); (2) increased risks of food and waterborne diseases (very high confidence) and (3) increased risk of undernutrition resulting from diminished food production in poor regions (high confidence) (Smith et al. 2014).

1.5 South and Southeast Asia

The scenario for climate change in South and Southeast Asia has been a major focus in the most recent Fifth IPCC Assessment. These scenarios indicate warming trends and increasing temperature extremes consistent with those observed across most of the Asian region over the past century (high confidence) (IPCC 2014).

The Fourth IPCC Assessment Report had stated that climate change, in particular via increased floods and droughts, is expected to have severe impacts on South Asian countries, whose economies rely heavily on agriculture, natural resources and forestry and fishery sectors. About 65 % of the population of South Asia live in rural areas and 75 % of them are poor, vulnerable and at risk of harm from climate change. Risks include changes in the intensity of rainfall and a possible alteration to South Asian monsoon pattern due to El Niño effects. Higher temperatures also increase the vulnerability of humans (including labourers), crops and stock.

Recently unprecedented rainfall and hailstorms in late March–April 2015 in northern India have added to the concern that climate change will exacerbate extreme events. These storms caused extensive crop damage, in turn contributing to a number of farmers committing suicides. Sharp increases in food prices were also noted. Densely populated low-lying mega-deltas in South Asia are another area identified as a particular risk (IFAD no date). A paper by Ronald Fuchs asserts that “Asia’s coastal megacities are increasingly vulnerable to flooding disasters resulting from the combined effects of climate change (manifested as sea level rise, intensified storms, and storm surges), land subsidence, and rapid urban growth” (Fuchs 2010).

Climate change is most likely to impact one of South Asia’s most precious resources: water. Per capita water availability is already under intense pressure, having fallen by 70% since 1950, due to rapid population growth and urbanization (ADB 2012–2013).

India’s water crisis has multiple causes, including poor or even no government planning, corporate privatisation, industrial and human waste (impairing quality as well as quantity) and government corruption. These pressures that are magnified by overall population increase are expected to rise to 1.7 billion by 2050. In turn high birth rates are contributed by poverty and low literacy rates, along with ongoing discrimination against women and girls. South Asia’s water scarcity is mirrored globally and could lead to future international political conflict. India is not immune from these risks (Snyder 2015).

In South Asia, home to nearly 1.7 billion people, cities are already feeling the pressure of population growth and urbanization. It is estimated that 22 of 32 major Indian cities already face daily water shortages. In Nepal’s capital, Kathmandu, many local residents have grown accustomed to waiting in queues for hours to obtain drinking water from the city’s ancient, stone waterspouts. In Karachi, Pakistan, electricity and water shortages have led to protests and citywide unrest (Surie 2015).

In South Asia, availability of fresh water is highly seasonal, with about 75 % of the annual rainfall occurring during the monsoon months. Climate change threatens water supplies by higher temperatures, changes in river regimes and a greater incidence of coastal flooding. Water availability is expected to decrease dramatically especially in the dry season (Langton and Prasai 2012).

Focussing on Southeast Asia, Yusuf and Francisco combined data on spatial distribution of various climate-related hazards (cyclones/typhoons, droughts, landslides, sea level rise) with two human indicators (population density and adaptive capacity) to analyse 530 subnational areas in seven Southeast Asian countries

(Indonesia, Thailand, Vietnam, Lao PDR, Cambodia, Malaysia and the Philippines). Based on this mapping assessment, they identified all parts of the Philippines, the Mekong River Delta in Vietnam, almost all of Cambodia, North and East Lao PDR, Bangkok (Thailand), West and South Sumatra and West and East Java (Indonesia) as the most vulnerable regions (Yusuf and Francisco 2009). Both South and Southeast Asian countries are vulnerable due to floods, with the region experiencing the largest number of events (1171) during 1980–2008, followed by storms (930 events). The data from UNISDR show that Bangladesh suffered the most with epidemics and pandemics, with 1500,000 people affected in 1991 followed by Indonesia.

Coker and his colleagues have identified that Southeast Asia is a “hotspot” for emerging infectious diseases, including drug-resistant pathogens and some with pandemic potential. Some of these infections have already exacted a heavy public health and economic toll, including severe acute respiratory syndrome (SARS) that rapidly decimated the region’s tourist industry. Influenza A (H5N1) has been particularly problematic in Southeast Asia and has had a profound effect on the poultry industry. The authors further assert that:

The regional challenges in control of emerging infectious diseases are formidable and range from influencing the factors that drive disease emergence, to making surveillance systems fit for purpose, and ensuring that regional governance mechanisms work effectively to improve control interventions. (Coker et al. 2011)

Thus disease ecological scenario in the South and Southeast Asian region (except Singapore) is highly vulnerable. This vulnerability has acquired a serious proportion when we consider the latest IPCC Fifth Assessment Report (2014) on Asia. The Report highlights that warming trends and increasing extreme temperature are exacerbated by coastal and marine systems that are under increasing stress from both climatic and nonclimatic driver. The geography of large coastal areas here also makes South and Southeast Asia two of the many places around the world that are susceptible to several different kinds of infectious diseases. Water scarcity is also a major challenge for most of the regions because of rapid and unplanned urbanization, industrialization and select regional economic development by climate change. In addition extreme climate events will have an increasing impact on human health. Frequent and intense heat waves in Asia will increase mortality and morbidity in vulnerable groups. Increase in heavy rain and temperature will increase the risk of diarrheal diseases, dengue fever and malaria. Increases in floods (as occurred in Pakistan in 2010 and in Thailand in 2011 and drought in India in 2009) will exacerbate rural poverty in parts of the South and Southeast Asian region due to impaired crop production.

The Asian Development Report (2012–2013) has reviewed human health vulnerability in South and Southeast Asia, a region undergoing the epidemiological transition with both communicable and noncommunicable diseases on rise. The Report found that infectious and parasitic diseases comprise 13.9% of total mortality, followed by respiratory diseases with 11.5% of total deaths. To sum up, there are widespread regional inequalities in the health effects of exposures related to water,

sanitation, hygiene and those caused by vectors, food and air pollution. The challenge from the climate and health perspective is to devise mitigation and adaptation policies that can lower these risks.

The Asian Development Bank, however, highlights the progress made towards achieving the Millennium Development Goals in South and Southeast Asian countries. Among 13 indicators, South Asian countries experienced slow progress for poverty reduction, reduced maternal mortality, under 5 and infant mortality, and basic sanitation. There has been no progress on the reduction of CO₂ emissions nor tuberculosis incidence (ADB 2012–2013). The ADB quoted the IPCC on disaster risk and climate adaptation, concluding that there is a need for smarter development and economic policies, with a focus on disaster risk reduction and adaptation. The report highlights that “Climate change can undermine both food security and livelihoods. It can depress agricultural productivity and increase food insecurity and malnutrition, particularly in children. It can also increase vector-borne diseases, multiplying the disease burden” (ADB 2012–2013).

According to the ADB, there will also be huge economic costs from unmitigated climate change. The Bank estimates that in Southeast Asia, the economic cost of climate change could be as high as 6.7 % of GDP per year by 2100. This is more than twice the world average (ADB 2012–2013).

An alternative conceptual framework is to consider the health problems of climate change in South and Southeast Asia (and elsewhere) as having three pathways – “primary”, “secondary” and “tertiary”. In this model, primary effects are considered the most causally direct impacts of climate change on health. They include increased mortality during heat waves as what repeatedly occurred in India and elsewhere in South Asia. In the month of May 2015 alone, more than 1200 people died due to heat wave mainly in southeastern states of Telangana and Andhra Pradesh, as well as in northern India (TOI 2015). The effects of “natural” disasters such as flooding, hailstorms, droughts and severe cyclones, all of which are arguably worsened by climate change (including sea level rise in coastal regions), are also considered “primary” in this conceptualization. “Secondary” effects include via ecological changes that alter the epidemiology of some infectious diseases and chronic diseases, for example, the 1994 malaria outbreak in the Rajasthan desert following from extremely heavy rainfall and flooding (Akhtar and McMichael 1996). The health impact of allergens and air pollution, each of which interacts with climate change, can also be considered secondary effects. Tertiary effects refer to large-scale events with complex, multidimensional causation, including migration, famine and conflict. Unfortunately, all three forms of tertiary health effects are seen in countries of the region (Singh et al. 2015). Heat stress, on a sufficient scale, could also be called a tertiary effect.

In summary, if left unchecked, there is the likelihood of severe, pervasive and irreversible impacts of climate change on people and ecosystems. The global scientific community is making an increasingly impassioned appeal to the world’s policymakers to combat what is now recognised as the challenge of our times (IPCC 2014).

The present book comprises studies on South and Southeast Asian countries in general with major focus on India, Nepal, Bangladesh, Indonesia, Malaysia, Thailand and Taiwan. This book is aimed at presenting a regional analysis pertaining to climate change and human health, focusing on climate change adaptation strategies in geographically and socioeconomically varied countries of South and Southeast Asia.

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