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Globalisation and Climate Change in Asia: the urban health impact

BARRY MUNSLOW & TIM O'DEMPSEY

ABSTRACT *Asia's economic development successes will create new policy areas to address, as the advances made through globalisation create greater climate change challenges, particularly the impact on urban health. Poverty eradication and higher standards of living both increase demand on resources. Globalisation increases inequalities and those who are currently the losers will carry the greatest burden of the costs in the form of the negative effects of climate change and the humanitarian crises that will ensue. Of four major climate change challenges affecting the environment and health, two—urban air pollution and waste management—can be mitigated by policy change and technological innovation if sufficient resources are allocated. Because of the urban bias in the development process, these challenges will probably register on policy makers' agenda. The second two major challenges—floods and drought—are less amenable to policy and technological solutions: many humanitarian emergency challenges lie ahead. This article describes the widely varying impact of both globalisation and climate change across Asia. The greatest losers are those who flee one marginal location, the arid inland areas, only to settle in another marginal location in the flood prone coastal slums. Effective preparation is required, and an effective response when subsequent humanitarian crises occur.*

The challenge of climate change could become a force for good in humanity. It calls for co-operation, planning ahead and thinking about the complex interconnectedness of social, economic, political, cultural and environmental systems. Globalisation produces great benefits, with rising income levels and improved human development indicators. But it produces losers as well as winners and the resultant problems of inequity. Scarce skilled people, doctors, nurses, engineers, economists, computer specialists and managers are drained from areas where they are most needed, to areas where they will be best rewarded.

Globalisation means market-driven supply and demand forces being predominant over need. Adding democracy to globalisation should mean balancing forces for growth with a counter imperative for redistribution. The new process of capitalist development is both dynamic and successful but it is

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also unequal. Essentially the key challenges for the 21st century are to channel the economic benefits of globalisation, to mitigate the risks of climate change and to prepare for effective humanitarian responses when and where crises occur.

Let us consider that most basic of human needs: food. Projections of regional changes in cereal production by the 2050s to 2080s suggest a decrease in yield of eight to nine per cent in India, Pakistan, Sri Lanka, Afghanistan, Bangladesh, Nepal, Bhutan, Maldives and Afghanistan, but an increase of yields in the Southeast Asian and Pacific states. The picture varies for China, Mongolia and Korea.¹ At the beginning of the new millennium four Asian countries appeared on the list of the top 15 states receiving food aid; these were North Korea, Bangladesh, Indonesia and Afghanistan.² Climate change will cause floods and drought in certain specific areas. Asian countries will need to prepare for the consequences.

Asia has astounded the world with its many success stories of rapid and sustained economic development.³ This is mostly the result of enlightened policies and the hard work and creativity of its peoples. In addition, the evidence suggests that Asia has used foreign aid more effectively than other parts of the world. World Bank data demonstrate the highest degree of project success, around 90 per cent, in East Asia and the Pacific, with South Asia demonstrating a clear and marked upward trend in satisfactory project success: up from 68 per cent in 1995–99 to over 85 per cent in 2000–04.⁴ Asian Development Bank statistics paint a more diverse picture, with high levels of success in Mongolia and the Central Asian Republics but dropping to under 50 per cent in the Philippines and Papua New Guinea.⁵

While many parts of Asia rely upon their economic dynamism to account for their success, it is important to know that where foreign aid is required, it can be used effectively. If Asia has generally faced the challenge of using aid well and effectively, can it do the same in meeting the challenge of delivering humanitarian relief responses?

The rural areas have their own particular set of problems. The first among these are the huge regions of poverty that exist in the more remote areas of the interior of the Asian continent. Wealth created in the cities of the coastal belt needs to be redistributed to these oceans of poverty in the interior by strengthening their infrastructure, productive capacity, health and education, thereby building human development capacity and also opening up economic opportunities in those areas from which labour is currently migrating. One in six people in Asia lack access to safe water: 655 million in total.⁶

A second massive problem is that the powerful economic growth of India and China in particular has created a commodities boom that may last for a generation, albeit with periodic dramatic fluctuations, as in 2008–11, when the global credit crunch hit. The high price of oil makes growing fuel crops such as sugar and grain seem attractive, but these will become even more expensive. As there is only a limited amount of land on which to grow crops, the price of food will grow also, because the newly affluent in Asia and Latin America wish to eat more meat, which increases demand in grain to feed animals and land used for growing fuel competes with land use for growing food.

According to the United Nations Environment Programme (UNEP) the human population has grown so large that ‘the amount of resources needed to sustain it exceeds what is available ... humanity’s footprint (its environmental demand) is 21.9 hectares per person while the Earth’s biological capacity is on average only 15.7 ha/person’.⁷

Asia’s challenge for the 21st century is managing the tensions that arise from globalisation and its benefits along with the costs of the attendant global climate change. In this article we explore some of the most pressing challenges that Asians face. First, there is the downside of the rapid industrialisation and urbanisation: urban air pollution and its attendant health effects. Second, waste management, particularly with the vast conurbations and rising affluence, will stretch human ingenuity to find solutions. Third, and perhaps most importantly, global warming will lead to rising sea levels, more intense weather events and increased vulnerability for the millions living in Asia’s coastal cities and low-lying islands. Finally, it may also lead to the problem of heatwaves, drought and the stress placed upon freshwater resources and agricultural land use in parts of the interior of the continent.

What challenges does Asia face?

Six out of every 10 people in the world live in the Asia and Pacific region. Climate change will have a major impact on many of the people living there, particularly where there health is concerned (see Table 1). Many parts of Asia will harbour climate victims of its remarkable economic success.

Droughts, heat-waves and urban air pollution

One key cost of economic growth and progress is measured by the high degree of urbanisation and urban air pollution. More than half the global population live in urban areas that consume 75 per cent of the world’s energy and account for 80 per cent of all greenhouse gas (GHG) emissions.⁸ Half a million people die every year from the health effects of air pollution, according to the World Health Organisation (WHO), and one billion Asian

TABLE 1. Examples of climate associated urban health threats

Risk factor	Communicable diseases	Non-communicable diseases
Heatwaves, drought, forest fires, dust storms, atmospheric pollution	Food poisoning, meningitis, respiratory infections, Nipah virus, West Nile virus, leishmaniasis	Cardiovascular disease, chronic respiratory disease, asthma and allergies, physical injury, heat stress, dehydration, bladder and renal stones, mental health problems
Rain storms, floods, urban waste	Diarrhoeal diseases (eg cholera), leptospirosis, hantavirus, Hepatitis A and E, dengue, malaria, Japanese encephalitis, plague	Drowning, injury, mental health problems, chemical toxins and physical hazards

people are exposed to outdoor air pollution above guideline levels. Air pollution is increasing as the demand for energy to fuel economic growth requires the building of large numbers of coal fired power stations. Coal accounts for 80 per cent of the electricity produced in China and 70 per cent of that in India.⁹ Growing affluence spurs the demand for motorcars and motor bikes, which grew by 10 per cent per year in India and China from the 1990s. In January 2008 the Indian manufacturer Tata introduced the people's car, only costing US\$2500, opening up the possibility of a further 60 million car owners in India alone. An additional source of air pollution in Southeast Asia comes from forest fires, in part as land is cleared for palm-oil production.

Without energy there can be no development. China has now become the major producer of CO₂ emissions, replacing the USA. Of course, per capita emissions are far lower than in the West. North America's and Europe's earlier industrial revolution were the main causes of current high levels of CO₂ emissions, which are the major cause of global warming and climate change. Yet, with political will, positive change can occur. Undoubtedly for many countries the success of economic policies runs far ahead of effective policies on health and on the environment. In addition to policy, legislative and institutional strengthening, a massive effort will be required to raise public awareness of the issues and to educate people about good practices in global climate change mitigation and adaptation.

China had 6911 coal-fired power units in 2005, most of them small and inefficient, and is currently building new power stations at an incredible rate. Under its 11th Five Year Plan the Chinese government has established a strategy for lowering future emissions based upon energy intensity, improving energy efficiency in the top 1000 enterprises, introducing advanced technology initiatives, retiring inefficient power plants and industrial enterprises and supporting renewable energy.¹⁰ China hosting the Beijing Olympics in 2008 brought the problem of air pollution high on the political agenda of the Chinese Communist Party and serious measures were taken to solve the problem.

Development produces increased CO₂ emissions, global warming and more air pollution, with the attendant health costs and long-term climate change effects. The urgent challenge is to address the key problem areas and take action to mitigate and adapt in the most effective way possible.

The urban heat island effect has been well described in Asia's mega-cities. Urban temperatures may sometimes climb to more than 10°C above those of the surrounding rural areas. Heat stress poses significant threats to human physical and mental health and well-being. Heatwaves are frequently accompanied by drought, dust storms, and bush and forest fires which themselves pose additional threats.

Seoul, with a quarter of South Korea's total population, is a dynamic urban success story, a winner in the globalisation process of capitalist development, being ranked the ninth most important city in the global economic system.¹¹ Yet it faces a number of significant problems. Rapid urbanisation produces a heat-island effect, as the massive concentration of infrastructure

causes thermal storage and alters the urban climate, heating it up.¹² Climate change resulting in more intense heat-waves will have negative health impacts in cities. While O'Neill *et al* extol the virtues of affluence riding to the rescue, in the form of air conditioning to counter these effects; the downside of air conditioning is increased GHG emissions.¹³

Seoul has registered an astonishing 1.5°C temperature increase in just three decades, two and a half times greater than the temperature increase of the surrounding rural and littoral areas.¹⁴ Research on the increase in daily mortality rates for Seoul as a result of increased heat shows ranges from 2.7 per cent to 16.3 per cent.¹⁵

What happens further inland in neighbouring Asian countries also affects the city of Seoul. Dust clouds from Mongolia and China arrive annually, engulfing the city for days and sometimes weeks.¹⁶ Dust storms in March 2010, coinciding with the severe drought in southwestern China, were the worst ever recorded.¹⁷ Increasing episodes of drought in Mongolia and China lead to storms of greater severity.¹⁸

Atmospheric brown clouds (ABCs), consisting of particulate matter and chemical aerosols, pose a significant threat to human health, particularly affecting people with underlying cardiovascular and respiratory disease. Over 80 per cent of the population in Asia are exposed to particulate matter levels exceeding WHO maximum recommended levels, in some regions by more than fourfold the recommended upper limit.¹⁹

Industrial pollution from China also gets carried as harmful particles in dust storms. A recent report on 'Long-Range Trans-National Air Pollutants in North East China', which was due to be released by the Korean Environment Ministry was delayed indefinitely by the Ministry as 'some found the content possibly troublesome to China'.²⁰ The challenge of greater regional co-operation will at times be complicated by power disparities between countries. Yet there are good examples of this working. South Korea is taking measures to address such problems. Seoul city government is investing in a tree-planting project in the Kubuqi desert west of Beijing in China, in a clear acknowledgement that national solutions alone will not provide all the answers. Important and decisive measures are required at the international, national and local levels. Seoul has developed its own master plan for low carbon green growth (see Table 2).⁸

TABLE 2. Key features of Seoul's 'Master Plan for Low Carbon Green Growth'

- Reducing GHG emissions by 40% by 2030
- Building regulations to include "green" building certificates for new builds
- All public transportation to be "green"
- Increase bike ridership to 10% and public transport to 70%
- Develop 10 new "green" technologies to be used in Seoul, creating 1 million "green" jobs
- Investment in healthcare sector eg development and provision of protective masks for yellow dust storms
- Set new standards for urban planning, including addition of 11km² green space to the city

Source: C40 Cities, *Cities and Climate Change*, C40 Cities, Climate Leadership Group, 2010, at <http://www.c40cities.org/climatechange.jsp>.

What these examples show is that political will can be present to introduce the technological and policy solutions required to address problems of urban air pollution. The UK did this with its Clean Air Act of 1968. These are solvable problems.

Global climate change will have a major effect upon water resources. A national Climate Change Assessment in China predicts deserts spreading, more frequent drought and a reduction in fresh water supplies.²¹ The 3-H river basins, Hai, Huai and Huang (Yellow) Rivers provide almost half of all of China's water needs. Globalisation and China's economic growth miracle mean that twice the sustainable extraction of water from these river basins is currently occurring. This has huge implications for the future. Much of China's grain, the core food, is produced in these basins, which account for one third of GDP, and one in two of the rural poor live here, primarily as farmers: 'As drought, rising temperatures and reduced runoff under climate change take effect, an obvious danger is that the adjustment costs will be borne first by the poor'.

In China the effects of globalisation and climate change can usefully be discussed along an east-west and north-south axis as the country is so very big. China's rapid economic development is being driven by the east coast ports of Tianjin, Shanghai, Guangzhun, Hong Kong and Hainan Island, which link China to the world through production and trade. China's western border is marked by the Tibetan plateau at 4500 metres and Central Asia's deserts, which present a formidable barrier to globalised production and trade.²² Not surprisingly people pack up and migrate from the poorer interior to the booming coastal cities.

In western China there are projected global warming temperature rises of one to 2.5°C by 2050. The 45 000 current glaciers of the Qinghai-Tibet plateaus are melting at the rate of 131.4 square kilometres per year.²³ The effects will be perverse. Initially there will be more flooding. Eventually, as the water disappears into the sea from the mountains, the economically vibrant coastal cities in the east of China will experience flooding, while the people living in the west of China will have a water scarcity—everyone will be affected. Already in 2005 there were 13 major dust storms, one of which deposited 330 000 tons of sand in Beijing.²⁴

In China the north-south divide will also have an impact. The north is very dry and increasing water scarcity will worsen the economic inequality. How to address these problems and what are the associated risks? As Jeffrey Sachs has commented:

Already China is talking about spending tens of billions of dollars to divert rivers from the South to the North in three great canals, whose costs, effectiveness and ecological effects are hard to assess with precision, but the risks are very large.²⁵

Mongolia has been badly affected by droughts. Almost half of the population are involved in animal breeding, accounting for 30 per cent of the country's exports; it is the main livelihood for one-third of households and the main food supplier for the urban areas.²⁶ Livestock roam on open pastures and are

highly dependent on the climate. Mongolia is warming at twice the global average,²⁷ with mean air temperature increasing 1.6°C between 1940 and 2001.²⁸ The increasing heat stress on plants and decline in soil moisture negatively affects the growing season. Extreme weather events are increasing in frequency.²⁹ A series of droughts between 1999 and 2002 affected well over half of the country, with 3000 water sources, including 680 rivers and 760 lakes, drying up and ten million animals dying in this period.³⁰ Spring, which is storm-prone with cold and changing weather, has increased in duration while summer has shrunk. Animals can no longer build up the reserves of fat necessary for them to cope with the harsh winters. This reduces livelihood security for the livestock-dependent population. Migration to the cities has been increasing as a result, with the population of the capital Ulaanbaatar more than doubling in the past decade.

The impact of urban heatwaves that have affected Europe over the past decade provide important lessons for Asia. In summer 2010, world attention was drawn to Russia's worst drought in over 100 years. As temperatures in the central plains averaged 42°C and sometimes soared above 50°C, wildfires involving over 816 000 hectares produced dense smoke clouds spanning hundreds of kilometres. The combined effect of the heatwave, peaks of ozone and air pollution dramatically increased mortality, particularly among the elderly in urban areas.³¹ Mortality rates in Moscow doubled in July 2010 as temperatures hovered around 40°C, with 5840 more deaths compared with July 2009, placing a severe strain on mortuary resources.³² The associated, and much greater, increase in morbidity threatened to overwhelm medical facilities. The final impact of the 2010 heatwave remains to be seen. However, given the additional hazard of smoke exposure, it is likely to be proportionately greater than that in Europe in 2003, where there was an estimated excess mortality of 70 000.³³ A 10-year analysis in 15 European cities, carried out by the PHEWE (Assessment and Prevention of acute Health Effects of Weather conditions in Europe) project estimated a two per cent increase in mortality in northern cities and three per cent in southern cities for every 1°C increase in apparent temperature above the city threshold level.³⁴

Andrei Klepach, Russia's deputy economy minister announced that the drought would take up to 0.8 per cent (\$10.1 billion) off the year's economic growth. Some experts have estimated that the figure could be as high as 1.5%. Grain shortages in Russia and the consequent export ban have also had an effect on world grain prices.³⁵

Storms, floods and urban waste

For the urban areas waste is a by-product of more affluent societies. People who used to live more simple lives left very little waste: everything was used. Growing per capita incomes and capitalism's success in cheap mass production create mountains of waste. Part of the waste is in the packaging but the waste that is increasingly difficult to control is the products themselves. In particular, all the electrical items produced and consumed heavily in Asia—cars, televisions, radios, computers, printers, refrigerators,

air conditioning units, cameras, mobile phones, DVDs and videos—have to go somewhere when their useful life ends. As part of the market mechanism there is built in obsolescence and constant product innovation drives the consumer to buy the latest and to disregard last year's 'must have' purchase in Tokyo, Ho Chi Minh City, Seoul and Singapore.

All the production created in Vietnam's, China's and Malaysia's factories can be found for sale in whole streets in Asia's cities dedicated to selling a single domestic commodity. Hanoi, for example, has its washing machine street, its video game street and its computer street.

But it is not simply Asia's own products that produce the continent's waste mountains. Over 90 per cent of the 20 to 50 million tonnes of electronic waste produced globally every year finishes its days in Asia. In particular, Bangladesh, India, Pakistan, China and Burma have electronic waste disposal industries that mainly use obsolete technologies.

The Philippines' capital city of Manila captures starkly a combination of problems: poor people in growing numbers settling in a conurbation vulnerable not only to flooding and typhoons but also earthquakes. Metro Manila has been expanding rapidly from a population of 2.5 million in 1964 to 12 million in 2000 and comprises 17 cities and municipalities.³⁶ A fifth of the population live near the poverty line, with over one-third in informal settlements.

Migrants flock to the city seeking to improve their livelihood, find a job, a house, and gain access to education, healthcare and other services. The reality for many urban migrants is rather different. An astonishing 150 000 people work on the Payatas dump sites. These people are called, at its most diplomatic, recycling workers, and at its worst 'scavengers'. They live near the site with their families, earning only a quarter to a half of the legal minimum wage of \$8 per day. They suffer from TB, respiratory diseases, parasitic infections and malnutrition, and face the dangers of toxic chemicals and methane gas.

The squatters have no formal health services available and rely on non-governmental organisations (NGOs) offering essential healthcare, education and feeding programmes. A typhoon which struck the Payatas dump site in 2000 led to a garbage landslide with 330 official deaths but in reality up to three times as many fatalities.³⁷ Although the site was temporarily closed in the aftermath, it was reopened the following year.

Problems of poverty, urban migration to coastal cities, massive levels of urban waste and vulnerability to sea level rise all come together in Manila. Work has been undertaken to identify the areas at risk of rising sea levels in Manila,³⁸ the number of flood events and the number of people affected, which reveals an impact surge in the final decade of the 20th century compared to the previous two decades.³⁹ Poor waste management contributes to flooding and stagnant water thereby increasing the spread of disease and death (see Figure 1).

Around 20 typhoons cross the Philippines annually, depositing 38 per cent of annual rainfall and inflicting a mortality rate 17 times higher than in Japan.⁴⁰ On 26 September 2009 typhoon Ondry hit the Philippines, killing 464

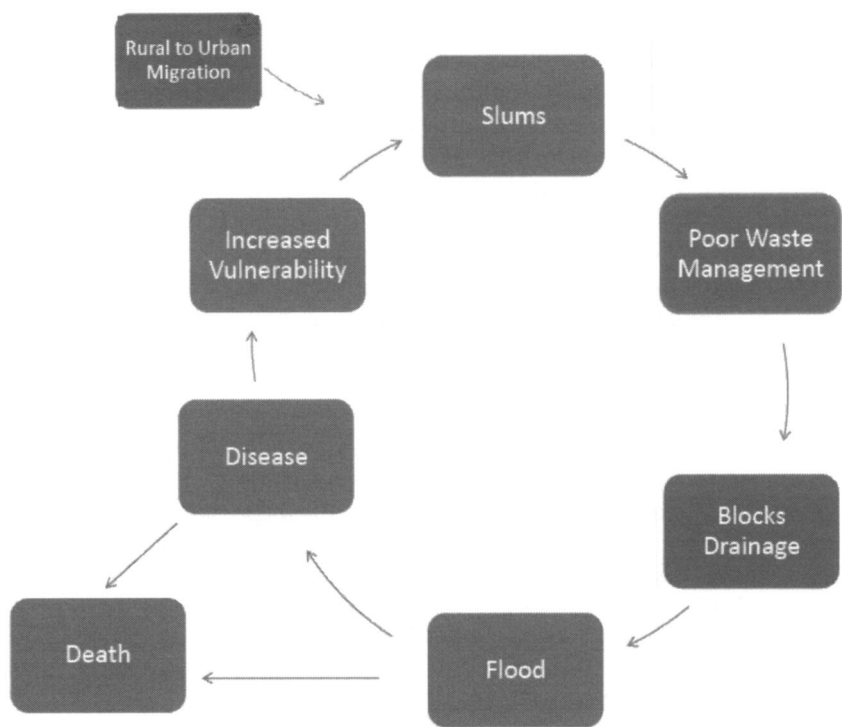


FIGURE 1. Factors associated with adverse health outcomes in urban floods.

people, displacing 450 000 and causing estimated damage of \$4.38 billion.⁴¹ Infrastructure damage hampered and disrupted the local medical responses. An epidemic of leptospirosis involved 3125 cases, caused 240 deaths and required the distribution of prophylactic antibiotics to 276 543 individuals.⁴²

Coastal flooding as a result of global sea-level rises, increasing hurricanes, storm surges and other related phenomena is a certainty. It is not the average rise in sea levels that causes the problems but the increasing variation around the mean. Shanghai, for example, is only four metres above sea level and is located at the mouth of the Yangtze River. The city's 18 million inhabitants face the threat of excessive river runoff from glacier melts, plus rising sea levels, summer typhoons and storm surges. Particularly vulnerable are the three million migrants from the rural areas, living with limited entitlements in flood prone areas in Shanghai.

In July and August 2010 Pakistan was inundated when more than half the normal three-month monsoon rainfall occurred in a just one week. Although the immediate impact on health was relatively limited (there were fewer than 2000 reported deaths and a similar number of injuries), in many other respects the scale of the disaster eclipsed that of other recent crises, including the South Asian tsunami of 2004 and both the Kashmir and Haiti earthquakes of 2005 and 2010, respectively. Over 160 000 sq km and 17–20 million people were affected, with more than 1.2 million rendered homeless. There was colossal damage to communications, transport, infrastructure and

agriculture: the economic impact is estimated at \$25–40 billion, and 20% of the country's cropland was inundated, with an estimated loss of \$2.8 billion. The burden of diarrhoeal diseases increased dramatically as floodwaters surged, and epidemics of malaria and dengue occurred as waters subsided. Given the disruption to transport and communications, increasing rates of malnutrition and the fact that over 380 health facilities have been destroyed or damaged by flooding, the morbidity and mortality associated with this disaster is likely to be amplified many times over.⁴³

Climate models have predicted such phenomena and warn us that many of the so-called 'natural' disasters of 2010 are a taste of what is to come. However, this disaster cannot be attributed entirely to the effects of global climate change. The flood plains of the Indus have been considerably reduced by the destruction of shrub land and forests in favour of arable land and by the construction of numerous barrages and miles of embankment. The carrying capacity of the canals designed to divert the water away from the flood plains was overwhelmed, causing flooding in populated areas.

An understanding of the extent to which the damage caused by these floods is human induced is essential for sustainable reconstruction of the physical and social infrastructure of flood-affected regions.⁴⁴

Climate change migrants: people and pathogens

Migration is a survival strategy many seek in adapting to the vagaries of climate change. The International Organisation for Migration defines climate change migrants as: 'persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment as a result of climate change that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or chose to do so, either temporarily or permanently, and who move either within their country or abroad'.⁴⁵

Living in Bangladesh makes people extremely vulnerable. Four-fifths of the country occupies a low-lying delta plain, vulnerable to dramatic tropical cyclones, storm surges and, more insidiously, processes of soil erosion and salinity of the soils.

People generally hate to leave their homes and communities. They adapt *in situ* to the effects of climate change. Migration is often a last resort, as resilience is worn down and adaptation and mitigation fail.⁴⁶ Yet migration may put both the migrants and the host communities at risk; it is no easy solution.⁴⁷ Estimates of climate change migrants vary. Myers suggests a figure of 200 million by 2050,⁴⁸ but at this stage this is more educated guesswork than science.⁴⁹ Measuring the numbers is extremely difficult as some flee from disasters en masse while others trickle away as soils degrade.

With international institutions responsible for traditional 'refugees' unwilling to accept responsibility for an entirely new and potentially huge number of people labelled environment or climate change refugees or migrants, the concepts are inherently political and contested terrain. Are those countries that caused the climate change responsible for picking up the bill for its migrant victims?

The location and manner in which most Bangladeshis sustain their livelihoods simultaneously puts their own lives at risk. Fishing and agriculture require proximity to the waters and fertile soils of the Brahmaputra delta. Two-thirds of the labour force relies on fishing and agriculture.⁵⁰ Soil erosion has been linked to migration, with three-quarters moving to safer locations locally but a quarter migrating to urban areas.⁵¹ Dhaka, the capital city, is undergoing a construction boom to accommodate the climate migrants.⁵² The twin pressures of a rising population, predicted to increase from 126 million in 2000 to 206 million by 2030,⁵³ and declining food production of 32 per cent for wheat and eight per cent for rice by 2050,⁵⁴ will increase migratory pressures.

Yet the supposed safety of the cities may be a chimera, as Dhaka and the coastal city of Khaluna are highly affected by flooding, sanitation and heat stress problems, particularly for the vulnerable migrants who locate to the most precarious locations. Furthermore, there are negative feedback effects of the urban migration that reinforce the problems, as outlined in Figure 1.

Human migrants rarely travel unaccompanied; our silent passengers include parasites, bacteria and viruses. Pathogens opportunistically exploit ecological and immunological niches as they become available. Human incursion into new or marginal habitats promotes the transfer and emergence or re-emergence of a variety of infectious disease pathogens. Rapid unplanned urbanisation and weak health systems accelerate the spread of communicable diseases associated with poverty and increase the vulnerability of communities to infection, disease and death. Human migrants may carry with them, or be at risk of exposure to and disease from, infections such as TB, HIV, malaria, gastrointestinal and respiratory pathogens. There may also be differences in the drug sensitivity patterns of these pathogens among migrants when compared to those of the settled population.

A 'perfect storm' is brewing in the Bay of Bengal. Cholera, the 'King of Terrors', is one of the most dreaded of epidemic and pandemic diseases. Death can occur within two hours of the onset of symptoms and case fatality rates of greater than 30 per cent are still commonly seen in epidemics where affected populations have little access to medical services. The estuaries that drain into the Bay of Bengal provide an ideal environment in which the organism can persist and proliferate. Epidemics of cholera have a direct association with climate variability. The organism's survival, proliferation and virulence is enhanced in marine and estuarine reservoirs when coastal water temperatures rise, favouring the proliferation of blue-green algae, to which the bacteria adhere and which, in turn, nourish copepods, that thus become tiny concentrated capsules of bacteria and effectively increase the infective dose of cholera when ingested by humans.⁵⁵ Cholera seasonality is related to algal blooms and cholera peaks in Bangladesh have been shown to be associated with the dominant frequency of El Niño.⁵⁶ Cholera's virulence is the result of its ability to produce a toxin that causes profound fluid loss from the intestine, resulting in profuse diarrhoea and vomiting in severe cases. However, not everyone who is infected develops symptoms and asymptomatic carriers are important in propagating the spread of cholera.

The 'classical' type of cholera, which historically is the more virulent, has a case:carrier ratio of 1:5, whereas the El Tor type has a case:carrier ratio of 1:50.

Evidence is emerging in some Asian regions that the virulence of *Vibrio cholerae* 01 El Tor, the current pandemic strain, has increased recently because this strain is now producing the more powerful toxin previously associated with the classical type. Epidemics caused by this more virulent El Tor strain are likely to be associated with higher case-fatality rates.⁵⁷

Rising sea levels, warmer coastal waters and increased frequency and intensity of storms will increase the risk of exposure to cholera not only among those populations residing in affected areas, but also among populations in regions where disaster migrants seek refuge. Such migrants are most likely to settle among poor urban communities where facilities for hygiene and sanitation are most basic. Distance and topography no longer pose barriers to the spread of cholera. Thus, the stage is set for an epidemic cascade of cholera with unprecedented reach that will threaten not only the health but also the economic well-being of the peoples of Asia and beyond.

Water also plays a crucial role in the emergence of the most rapidly spreading mosquito-borne viral infection in the world. Dengue, dubbed 'the prosperity bug', is transmitted by day-biting *Aedes* mosquitoes which are well adapted to urban environments, exploiting a myriad of possible breeding sites almost anywhere that water collects.⁵⁸ Whereas the incidence of many other vector-borne diseases has fallen in Asia's cities, that of dengue has steadily increased. Primary dengue, also known as 'break-bones fever' because of the severity of symptoms, can be very debilitating but is unlikely to cause death. However, hyperendemic dengue transmission, in which multiple dengue serotypes are circulating in a susceptible human population, is associated with life-threatening dengue hemorrhagic fever (DHF).

Dengue has steadily spread from Southeast Asia into neighbouring Asian countries including southern China and Taiwan, Pakistan, India, Sri Lanka and Malaysia, throughout Indonesia, to New Guinea, the Philippines and as far north as eastern Australia and several Pacific islands. Since 2000 dengue outbreaks have been reported in eight previously dengue-free locations, including Nepal, Bhutan, Macau and Hong Kong. Unplanned urbanisation is chiefly responsible for disease amplification, while increased travel and migration, of human host and insect vector, has extended dengue's global reach.⁵⁹

Hyperendemic dengue transmission is established in urban populations in Vietnam, Thailand, Indonesia, Pakistan, India, Malaysia and the Philippines. The first epidemic of DHF was described in Manila in 1953. Subsequently DHF has become a leading cause of hospital admission and death among children in Southeast Asia. Moreover, recent epidemiological studies have indicated an upward trend in the age of those affected and an increasing mortality rate. Individuals older than 15 years have accounted for more than 50 per cent of DHF deaths in Singapore since 1982, and in Bangladesh during the 2000 epidemic 82 per cent of hospitalised patients were adults, and all deaths occurred in patients older than five years.⁵⁸

Epidemic waves of dengue emerge from urban epicentres in three- to five-year cycles.⁶⁰ At present the extent to which climate change is playing a part in the changing epidemiology of dengue remains uncertain. However, there is evidence that a rise in environmental temperature can both increase the longevity of the mosquito vector and shorten the incubation period of the virus within the mosquito. The net result is that there are more infected mosquitoes and that these survive for longer.⁶¹ We also know that 87 per cent of the population in the Southeast Asian region are at risk of dengue, more than 25 million cases occur annually and incidence rates are increasing, case-fatality rates of between one and five per cent are common, urban populations are particularly vulnerable and the annual economic cost is measured in billions of dollars.⁶²

Discussion

There is a need to strengthen capacity across all Asian countries to deal with possible humanitarian emergencies in the future. Climate change will add to the pressures of armed conflicts and natural disasters such as the tsunami of 26 December 2004. Over three quarters of the worst natural disasters, as measured by numbers killed, during the 20th century occurred in Asia. In China there were the floods of July 1931 and July 1959, the drought of 1928 and bubonic plague of 1909. In India it was the droughts of 1942 and 1965–67, and the bubonic plagues of 1907 and 1920. In Bangladesh, it was the famine of 1943. All of these counted deaths in their millions. In more recent times the 1976 earthquake in China cost a quarter of a million lives and the tsunami of 2004 a similar number, principally in Indonesia, Sri Lanka and Thailand.

Hazards that trigger disasters have always been with us and will continue to be so. The extent of a disaster depends upon the vulnerability of the people affected by the hazard. The key concept is that of vulnerability:

[A] function of exposure, sensitivity to impacts and the ability or lack of ability to cope or adapt. The exposure can be to hazards such as drought, conflict or extreme price fluctuations, and also to underlying socio-economic, institutional and environmental conditions. The impacts not only depend on the exposure but also to the sensitivity of the specific unit exposed (such as a watershed, island, household, village, city or country) and the ability to cope or adapt.⁶³

Poor urban communities are particularly vulnerable to adverse health effects resulting from global climate change. The rich, living in air-conditioned apartments and driving air-conditioned cars, are to some extent protected from heat stress; however, their vulnerability begins to converge with that of the poor with regard to other climate-associated health threats and, while communicable diseases pose a greater threat to the poorest members of society, their reach can readily extend to the rich.

Human infectious disease threats arising from climate change are the result of complex interactions between host, pathogen and environment. Current

trends in temperature, precipitation and sea-level changes are affecting vector and pest habitats, availability and quality of water and food, and human migration in the wake of increasing competition for scarce resources, of natural disasters and of conflict. Effective early warning systems, disaster preparedness, contingency planning, disease surveillance, epidemic intelligence and response must be improved.

There is one clear lesson to be learnt. In order to reduce the risks of climate change we have to reduce vulnerability to climate change. What does this mean in practice? It means training people and building systems to deal with the inevitable traumas that Asia will have to face along with every other continent. This work is going on already in institutions such as the Asian Disaster Preparedness Centre. The regional picture, however, is patchy and more effort is required. There is a growing body of scientific academic opinion that is warning of the consequences of not addressing these issues. As one article commented: 'A focus that neglects to enhance capacity-building and resilience as a prerequisite for managing climate change risks, will, in all likelihood, do little to reduce vulnerability to those risks'.⁶⁴

There is a wider problem in the professionalisation of humanitarian assistance. Quite simply for too long humanitarian action was the preserve of enthusiastic and well-meaning amateurs in NGOs. If the challenge of climate change is truly to be addressed then this requires a professionalisation of the training of NGOs. Furthermore, for successful responses to humanitarian emergencies there needs to be a new perspective that facilitates the improved co-ordination of governmental, non-governmental and community-based responses to the multiple hazards that globalisation and climate change will produce. Humanitarian organisations, donors and governments have devoted significant attention to the issues of accountability, professionalism and co-ordination in recent years. Landmark examples include the multi-agency Sphere Project and the Active Learning Network for Accountability and Performance in Humanitarian Action (ALNAP), both established in 1997, and the Good Humanitarian Donorship forum and the Humanitarian Accountability Initiative of 2003.⁶⁵ Following the Humanitarian Response Review in 2005 the international humanitarian community developed the Humanitarian Reform Agenda, which aims to enhance the timeliness and effectiveness of humanitarian responses, to prioritise the allocation of resources and to offer more comprehensive needs-based relief and protection. The bed-rock of humanitarian reform is increased capacity, predictability, accountability, and partnership among humanitarian actors. This forms the foundation for the three 'pillars' of reform:

1. improving the predictability of funding through the Central Emergency Response Fund;
2. strengthening the Humanitarian Coordinator System; and
3. using the Cluster Approach to co-ordinate effective responses through global and country cluster-led organisations addressing gaps in activities such as health, water/sanitation, logistics, nutrition, emergency shelter,

camp co-ordination and management, emergency telecommunications, protection, education, agriculture and early recovery.⁶⁶

A major challenge that continues to elude many humanitarian and development organisations lies in the gap between emergency relief and sustainable development.⁶⁷ Global climate change is increasingly creating tipping points at which development collapses into disaster. NGOs are now actively engaging with the scientific community, governments and donors in addressing climate change challenges. For example, the Climate Action Network (CAN), a global network of about 500 NGOs is working to promote government and individual action to limit human-induced climate change to ecologically sustainable levels.⁶⁸

National governments within the Asia Pacific region are gradually moving towards a Green Growth approach to economic development. Green Growth advocates growth in GDP that maintains or restores environmental quality and ecological integrity, while meeting the needs of all people with the lowest possible environmental impacts.⁶⁹ Many Asia Pacific countries now have a National Adaptation Programme of Action (NAPA) which synthesises information on their climate-related vulnerability, identifies key adaptation measures and prioritises action points. On submission of the NAPA, Least Developed Countries become eligible to apply to the Global Environment Facility for designated funding for implementation of their NAPA, recognising that any delay in addressing vulnerabilities will probably exacerbate vulnerability and increase the cost of later adaptation.⁷⁰ Another important and novel approach to climate-change mitigation and adaptation is the Asian Cities Climate Change Resilience Network (ACCCRN), which aims to catalyse information sharing, funding and action on increasing the resilience of poor and vulnerable people to climate change by creating partnerships between cities, institutions, financiers and consultants.⁷¹

Building a sustainable capacity for training people to deal with humanitarian emergencies in all their various forms across the Asian continent would appear to be a good way of building long-term neighbourliness, and a history of successful co-operation can help reduce tensions and bring a positive benefit to humanity from inevitable climate change and its predictable and, more worryingly, unpredictable effects. It is important to be clear that no country is an island under globalisation. Whatever happens to the poorest and worst affected country will have a serious impact on all its neighbours. That is the cost to go with the benefits of globalisation.

Notes

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