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The health impacts of climate change in Asia-Pacific

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Abstract

Climate change threatens human health. A report from *The Lancet*, the world's leading general medical journal, declared climate change as "the biggest global health threat of the 21st century". While climate change affects the world over, the Asia-Pacific region stands particularly vulnerable to its adverse consequences where more than half (or 56%) of the world's estimated 7 billion population and nearly two-thirds of the world's poor live. In the 1990s, Asia-Pacific accounted for 32% of global extreme climatic events, 84% of deaths caused by such events and 88% of people affected worldwide. Women are "the most vulnerable to climate change" and its negative health consequences in developing countries. It is estimated that the mortality risk of women during disasters is 14 times higher than that of men. Poor women, who constitute the majority of the poor in the Asia-Pacific region, are particularly vulnerable to climate-sensitive health risks.

This paper explores available data on the observed and projected linkages between climate change and health in the Asia-Pacific region. It highlights key health risks and vulnerabilities due to climate change and extreme climatic events, including infectious diseases, injuries, and other morbidities. Particular health vulnerabilities of women and girls to climate change impacts, along with other vulnerable populations, are also examined

Key words: Climate change, natural disasters, health impact, impact on women, Asia and the Pacific

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The health impacts of climate change in Asia-Pacific

1. Introduction

Climate change threatens human health. A report from *The Lancet*, the world's leading general medical journal, declared climate change as "the biggest global health threat of the 21st century."¹ While the health impact of climate change is still not fully understood,² an emerging body of scientific evidence and empirical data appear to indicate a strong association between climate change and human health.

The 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-4)³ noted that climate change was causing morbidity and premature mortality around the globe and its health impacts are expected to aggravate significantly over time. Due to its far-reaching impacts on human health and development, climate change is considered to be an impediment to achieving the Millennium Development Goals.⁴

WHO affirms that climate change affects human health by degrading the quality of air and water, food security, and shelter, all of which are indispensable to maintaining health.⁵ Weather events and diseases that are highly sensitive to changing climate are claiming nearly 10 million deaths across the world every year; from urban air pollution, diarrhoea, malnutrition and natural disasters combined.⁶

1-1. Vulnerability of the Asia-Pacific region

While climate change affects the world over, the Asia-Pacific region stands particularly vulnerable to its adverse consequences where more than half or 56% of the world's estimated 7 billion population⁷ and nearly two-thirds of the world's poor live.⁸ Empirical data demonstrate the scale and magnitude of such vulnerability.

According to the 2010 Asia Pacific Disaster Report,⁹ people in Asia-Pacific are 4 and 25 times more vulnerable to natural disasters when compared with people in Africa and in North America/Europe, respectively. Asia accounted for 75% of more than 2 million deaths caused by 6,367 natural disasters recorded between 1974 and 2003.¹⁰ In 2008, Asian countries were listed in nine out of the top ten countries in the global statistics of deaths attributable to natural disasters.¹¹

The number of extreme climatic events such as floods, heat waves, droughts, intense storms and tidal surges in Asia and the Pacific grew from 617 in the 1980s to 667 in the

¹ Costello et al. 2009.

² Ibid.

³ IPCC 2007.

⁴ Staringa 2008; McMichael et al. 2008; IPCC 2001a.

⁵ WHO 2009b.

⁶ Ibid.

⁷ UNFPA 2011.

⁸ USAID 2008.

⁹ UNESCAP and UN International Strategies for Disaster Reduction 2010.

¹⁰ Guha-Sapir et al. 2004.

¹¹ Centre for Research on the Epidemiology of Disasters 2009.

1990s,¹² or an 8% increase. During the same period, however, the number of deaths attributable to such events increased over 5-fold, from 90,000 to 500,000. The record implicates a growing intensity and expanding geographical coverage of extreme climatic events in the region. In the 1990s, the Asia-Pacific region accounted for 32% of global extreme climatic events, 84% of deaths caused by such events and 88% of people affected worldwide.¹³

Bangladesh experiences only 1% of all cyclones in the world. However, approximately 50% of global deaths due to cyclones are registered in Bangladesh,¹⁴ where over 70% of the country¹⁵ and 80 million people¹⁶ are flood-vulnerable.

Given a large number of people living in areas prone to flooding and other extreme climatic events in many parts of Asia, it is estimated that a 40cm rise in sea level by 2080 would cause the displacement of about 76 million people in South and Southeast Asia,¹⁷ with significant adverse health implications.

The low-lying nature of Pacific Island countries and territories are also highly vulnerable to climate change, particularly along coastal areas, due to rising sea levels, cyclones, and tidal surges. The highest points in Kiribati, Republic of the Marshall Islands, Tokelau and Tuvalu are just about 4 meters above sea level.¹⁸ Except for Papua New Guinea, Solomon Islands and Fiji, coastal areas are where the majority of the Pacific's 9.5 million people live. The Secretariat of the Pacific Community declares that "[C]limate change is among the most serious challenges facing Pacific Island countries and territories."¹⁹

In 2000, many LDCs and developing countries in Asia such as Bangladesh, Bhutan, India, Maldives, Myanmar and Nepal were already carrying the world's highest disease burden from diarrhoea and malnutrition, which are sensitive to climate change.²⁰ It is estimated that mortality risk from vector-borne diseases is almost 300 times greater in developing countries as compared with developed countries.²¹ Increasing frequency, intensity, and geographical range of extreme climatic events could reinforce, perpetuate and exacerbate enormous pre-existing public health challenges and further strain already fragile and overstretched health systems²² in Asia and the Pacific.

¹² WHO 2003.

¹³ Based on WHO 2003.

¹⁴ Amadore et al. 1996, as cited in Woodward et al. 1998.

¹⁵ Mizra 2003.

¹⁶ UNESCAP 1995.

¹⁷ IPCC 2001a.

¹⁸ Rodgers 2009.

¹⁹ Ibid.

²⁰ UNFCCC 2007.

²¹ WHO 2009b.

²² WHO 2006a.

2. Various health impacts of climate change

Climate change affects human health both directly and indirectly (e.g. by affecting disease vectors).²³ Deaths, injuries and disabilities can occur as direct consequences of extreme climatic events such as heat waves, floods, and storms. For example, a 2008 cyclone in Bangladesh killed 3,300 and affected over 8.5 million people.²⁴ Also in 2008, Cyclone Nargis killed 138,366 in Myanmar, resulting in the economic loss of nearly 30% of its GDP.²⁵

In India, 1,300 and 3,000 people died as a result of heat waves in 1988 and 2003, respectively.²⁶ The 2008 flood in the state of Bihar in India, attributable partly to glacial melting of the Himalayas due to global warming, affected 4.4 million people, inundated 290,000 hectares of land²⁷ and destroyed 225,000 houses.²⁸

The glacial melting in the Himalayas exacerbates the risk of floods, soil erosion, landslides and glacial lake outburst floods during the wet season in Nepal, Bangladesh, Pakistan and northern part of India.²⁹ It could undermine the water availability and quality and therefore elevate health risks of 1.3 billion people who rely on nine rivers originating from the Himalayan region.³⁰

WHO reports that floods triggered by a continuous sea level increase are projected to affect 94 million people in South Asia by 2100, as compared with the current estimate of 13 million.³¹ In addition to deaths, physical injuries and diseases, people who experience flooding may also be at risk of psychological disorders.³² Droughts in some semi-arid regions of India have been continuously associated with increased reporting of suicide among poor male farmers.³³

2-1. Infectious diseases

Climate change affects mortality and morbidity by creating favourable environments for, and altering the distribution of, climate-sensitive infectious diseases, particularly water-, food- and vector-borne diseases.³⁴ For example, warmer climate often increases the risk of mosquito-transmitted diseases such as dengue fever and malaria.³⁵ It does so by shortening disease incubation time and breeding cycle, and by increasing feeding frequency. In the case of dengue fever, disease transmission from mosquitoes to humans becomes more efficient in high temperature.³⁶

²³ IPCC 2001.

²⁴ WHO 2008d.

²⁵ Centre for Research on the Epidemiology of Disasters 2009.

²⁶ Confalonieri et al. 2007.

²⁷ Costello et al. 2009.

²⁸ WHO 2008f.

²⁹ UNFCCC 2007.

³⁰ Ibid.

³¹ Staringa 2008

³² Ahern et al. 2005; WHO 2008e, cited in Chand and Murthy 2008.

³³ Behere and Behere 2008, cited in WHO 2011a; Nagaraj 2008, cited in WHO 2011a.

³⁴ WHO 2008a.

³⁵ Ibid.

³⁶ Ibid.

Reduced availability of safe drinking water caused by droughts, floods, or intrusion of warmed salt water into fresh water due to sea level rise increases the risk of diarrhoeal diseases.³⁷ Lack of proper sanitation and hygiene systems and close gathering of people displaced by flooding³⁸ or storms further elevate the risk.

2-1-1. Dengue fever

An article from the journal of *Lancet Infectious Diseases* affirms that “[d]engue is perhaps the most important of the emerging infections that are likely to be affected by climate change.”³⁹ According to WHO,⁴⁰ dengue threatens health of 2.5 billion people with a global estimate of 50-100 million infections every year.

Epidemics of dengue haemorrhagic fever, which is a severe manifestation of dengue fever, were registered only in 9 countries prior to 1970, but then spread to more than 100 countries by 1995. The most affected regions in the world are Asia and the Pacific, where more than 1.8 billion people or over 70% of the global population at risk of dengue live.⁴¹ Dengue haemorrhagic fever accounts for the highest childhood mortality in some Asian countries.⁴²

While no concrete evidence seems to exist yet on the association between climate change and dengue outbreaks in the region,⁴³ existing data may indicate such possible connection. For example, Singapore observed an increase of 1.5 degree Celsius in the annual temperature between 1978 and 1999. During the same period, the annual number of dengue cases soared over 10-fold, from 384 to 5,285 cases.⁴⁴

Malaysia also experienced a dramatic rise of dengue fever cases over the past three decades, from less than 1,000 in 1973 to 46,000 in 2007.⁴⁵ In Bangladesh, no serious dengue epidemics were registered before the year 2000. However, the number of dengue cases between 1999 and 2005 reached nearly 20,000, with an annual average of 3,305 cases.⁴⁶ Bhutan, Timor-Leste, and Nepal reported dengue epidemics for the first time in 2004, 2005, and 2006, respectively.⁴⁷ In South Pacific, dengue epidemics between 1970 and 1995 were found to be associated with La Niña conditions, which brought warmer and wetter weather patterns.⁴⁸ Dengue outbreaks were observed in 14 Pacific Island Countries and territories in 2009.⁴⁹

³⁷ Ibid.

³⁸ Haines et al. 2006.

³⁹ Senior 2008.

⁴⁰ WHO 2012.

⁴¹ WHO 2010b.

⁴² WHO 2006b.

⁴³ WHO 2008b.

⁴⁴ Ibid.

⁴⁵ Benitez 2009.

⁴⁶ Rahman 2008.

⁴⁷ WHO 2006b.

⁴⁸ Hales et al. 1996, cited in WHO 2003.

⁴⁹ WHO n.d.-a.

2-1-2. Malaria

WHO projects that about 5% of the global malaria cases, or 21 million cases, would be attributable to climate change in 2030.⁵⁰ Although the overwhelming majority of malaria cases and deaths are recorded in Africa, Asia and the Pacific is the second-leading region accounting for 16.5% and 3.6% of the global malaria cases and deaths, respectively.⁵¹

Due to climate warming, mosquitoes that carry malaria parasites are today detected in high-elevation areas of Papua New Guinea, India and Bhutan where they were non-existent in the past.⁵² There is evidence of a positive correlation between El Niño that brings warm temperatures and malaria epidemics in various parts of South Asia.⁵³

Bangladesh has observed a continuous growing number of malaria cases, from 1,556 in 1971, 15,375 in 1981, 30,282 in 1991 to 42,012 in 2004,⁵⁴ or a 2.7-fold increase over 33 years. Although improved detection and surveillance may have contributed to the growing records of malaria cases in Bangladesh⁵⁵ and other countries, a potential impact of global warming cannot be ruled out, particularly given such a dramatic increase in a few decades.

2-1-3. Diarrhoeal diseases

Climate-sensitive weather events, particularly floods and droughts, are linked to diarrhoeal diseases.⁵⁶ Degraded water, sanitation and hygiene factors, highly affected by floods and droughts, are estimated to be responsible for 88% of global diarrhoeal cases.⁵⁷

Studies indicate evidence of a positive correlation between flooding and subsequent epidemics of diarrhoeal diseases such as cholera.⁵⁸ Overcrowding of people displaced by floods or other disasters can further elevate the risk of diarrhoeal disease transmission.⁵⁹ Three per cent of global diarrhoeal cases, or 132 million, were projected to be attributable to climate change in 2010.⁶⁰

Climate change will exacerbate the existing vulnerability of the Asia Pacific region to diarrhoeal diseases. About 2 billion and 638 million people in the region do not have access to improved sanitation and safe water, respectively.⁶¹

⁵⁰ WHO 2008a.

⁵¹ Based upon figures from the WHO's South-East Asia and Western Pacific regions, which together cover 47 countries and areas in Asia and the Pacific. See WHO 2010a.

⁵² WHO 2008b; Dhimal and Bhusal 2009.

⁵³ Haines et al. 2006.

⁵⁴ Rahman 2008.

⁵⁵ WHO 2011b.

⁵⁶ Senior 2008.

⁵⁷ Rahman 2008.

⁵⁸ Biswas et al. 1999; Ivers and Ryan 2006; Sur et al. 2000; Schwartz et al. 2006.

⁵⁹ Haines et al. 2006; Aghababian and Teuscher 1992; Kunii et al. 2002.

⁶⁰ WHO 2008a.

⁶¹ WHO 2008c.

The 2008 WHO report *Health in Asia and the Pacific* reveals that one million annual cases of diarrhoea disease are reported in the Philippines and Viet Nam.⁶² Diarrhoea was the second leading cause of morbidity in Cambodia in 2004. It was the fifth leading cause of morbidity and the third leading cause of mortality in Lao People's Democratic Republic in 2000. More than 450,000 deaths were attributed to diarrhoeal diseases in India in 2002, which reported over 9 million such cases.

The IPCC-4 report projects that East, South, and South East Asia will see an increase in morbidity and mortality from diarrhoeal diseases associated with floods and droughts that are affected by climate change.⁶³ Rising coastal water temperature due to global warming is expected to worsen the prevalence and toxicity of cholera in South Asia.⁶⁴ In Bangladesh, evidence confirms that cholera epidemics in its coastal areas are associated with the arrival of El Niño.⁶⁵

Diarrhoeal diseases are the second leading cause of under-5 mortality in the world.⁶⁶ Nearly 2.5 billion children under 5 contract the disease and 1.5 million of them die every year. A 10% improvement in accessing safe water is believed to bring down the child mortality by 3-4%.⁶⁷

Children in the Asia Pacific region, particularly South Asia, are highly susceptible to diarrhoea. According to the WHO/UNICEF 2009 report,⁶⁸ nearly 50% of the 2.5 billion global diarrhoea cases and of 1.5 million deaths due to diarrhoea are recorded annually in Asia and the Pacific.⁶⁹ Diarrhoea is responsible for 38% of under-five child mortality in South Asia where India has the highest number of child diarrhoeal deaths in the world.

⁶² WHO 2008c.

⁶³ Cruz et al. 2007.

⁶⁴ Rahman 2008.

⁶⁵ Ahern et al. 2005; Haines et al. 2006.

⁶⁶ UNICEF and WHO 2009.

⁶⁷ WHO 2005.

⁶⁸ UNICEF and WHO 2009.

⁶⁹ Ibid.

2-2. Malnutrition

Climate change can expose people to a greater risk of malnutrition⁷⁰ and food insecurity. WHO pronounces malnutrition as “the largest health effect” of climate change.⁷¹ Varying rainfall patterns, climates, floods, droughts, and seawater warming catalysed by climate change, are expected to reduce agricultural, fishery and aquacultural outputs, which could induce hunger and malnutrition. By 2030, climate change is projected to account for about 4.7 million cases of malnutrition, or about 10% of the global total.⁷²

The IPCC-4 report⁷³ predicts that climate change could reduce agricultural yields by up to 30% in Central and South Asia⁷⁴, leading to “a very high risk of hunger” in some countries of the regions. In Bangladesh, climate change may cause by 2050 an 8% and 32% reduction in rice and wheat production, respectively.⁷⁵ In the small Pacific country of Niue, a cyclone in 1990 changed the country from food-exporting to food-importing for the subsequent 2 years.⁷⁶

It is projected that crop yields could increase up to 20% in East and South-East Asia while they could decrease up to 30% in Central and South Asia by the mid-21st century. Taken together, and considering the influence of rapid population growth and urbanisation, the risk of hunger is projected to remain very high in several developing countries in the region.

Climate change is also likely to affect the amount of marine fishery catch, up to a 40% decrease in tropical countries.⁷⁷ This could threaten food security and livelihoods, thereby potentially causing health deterioration. UNEP estimates that climate change will affect 2.6 billion people worldwide who source their protein from seafood.⁷⁸ According to FAO,⁷⁹ 400 million people in the poorest countries derive at least 50% of animal protein and minerals from fish and fish products. Its health implications are profound for the Asia Pacific region with a very large number of people living in coastal areas who are likely to depend heavily on seafood.

Fisheries and aquaculture also provide livelihood opportunities for more than 500 million people in developing countries.⁸⁰ In the Mekong delta region, more than 500,000 people, mostly women, depend on catfish aquaculture for their livelihoods.⁸¹ However, increasing salt water intrusion due to sea level rise and reduced river flow associated with climate change is threatening the future of the industry, livelihoods and human health.

⁷⁰ In this report, the term ‘malnutrition’ denotes ‘undernutrition’ or poor nutritional status and not ‘over-nutrition’ such as obesity, which is also part of malnutrition.

⁷¹ WHO 2008a.

⁷² Ibid.

⁷³ UNFCCC 2007.

⁷⁴ Cruz et al. 2007.

⁷⁵ *The Hindu* 2008.

⁷⁶ Science 2007.

⁷⁷ Cheung et al. 2009, cited in FAO 2011.

⁷⁸ UNEP 2008.

⁷⁹ FAO 2009.

⁸⁰ Ibid.

⁸¹ Ibid.

Regardless of the future impact of climate change on food availability, millions of children are already suffering from various forms of malnutrition in the world today: 171 million under-five children from stunting, 115 million children from wasting and 20 million children from life-threatening severe acute malnutrition. It costs 3.9 million children's lives every year.⁸² Malnutrition is believed to be responsible for about half of child mortality worldwide, and for 57%, 64% and 52% of child deaths from malaria, diarrhoea and pneumonia, respectively.⁸³

Malnutrition is highly prevalent across Asia. Of the global malnourished children of 150 million, about 67% or 100 million are estimated to live in Asia and the Pacific, particularly South Asia.⁸⁴ The World Bank reports that India accounts for one-third of malnourished children in the world and its prevalence is among the highest, which is twice as high for the corresponding figure from Sub-Saharan Africa.⁸⁵

Furthermore, in South Asia and South-East Asia, the prevalence of underweight among women of reproductive age is 45-60%, while 80% of pregnant women are iron-deficient.⁸⁶ Over 20% of maternal mortality in India is attributable to malnutrition.⁸⁷ WHO estimates that 87% of women in India are anaemic.⁸⁸ Anaemia, a manifestation of malnutrition, elevates the maternal mortality risk at childbirth by up to 20%.⁸⁹ It causes annual deaths of 65,000 women in childbirth in Asia,⁹⁰ where it is the second leading cause of maternal mortality.⁹¹

Countries with more than 40% of stunting among under-five children in Asia include Afghanistan, Bangladesh, Cambodia, India, Lao People's Democratic Republic, Nepal and Democratic People's Republic of Korea.⁹² In Nepal, 50% of under-five children were stunted in 2006, which is also an indicator of malnutrition.⁹³

Extreme climatic events such as floods and droughts and subsequent crop failures, disruption of supply chains, loss of livelihoods, and food price increase could exacerbate the extent of the region's existing vulnerability to malnutrition-related morbidity and mortality.

Empirical and projected figures shown above reveal the high susceptibility of Asia and the Pacific to climate-sensitive mortality and morbidity risks. They elucidate the extent of actual and potential public health effects of climate change in developing countries of the region, which are further multiplied by already existing health vulnerabilities, disease burden and widespread poverty.

⁸² WHO 2011c.

⁸³ Gragnolati et al. 2005.

⁸⁴ UNICEF 2002.

⁸⁵ Gragnolati et al. 2005.

⁸⁶ WHO 2011a.

⁸⁷ FAO 2006.

⁸⁸ WHO 2009a.

⁸⁹ FAO 2002, cited in WHO 2011a.

⁹⁰ Gillespie and Haddad 2001.

⁹¹ Sanghvi et al. 2010.

⁹² UNICEF 2002.

⁹³ Eriksson et al. 2008.

3. Health impact of climate change/extreme climatic events on women

Women are “the most vulnerable to climate change”⁹⁴ and its negative health consequences in developing countries.⁹⁵ More women are killed by natural disasters and at a younger age compared to men.⁹⁶ It is estimated that the mortality risk of women during disasters is 14 times higher than that of men.⁹⁷ Natural disasters have been found to exert a greater negative influence on the life expectancy of women in comparison with men.⁹⁸ Poor women are particularly vulnerable to climate-sensitive health risks,⁹⁹ who constitute the majority of the poor in the Asia-Pacific region.¹⁰⁰

Besides increased health risks of women as a direct consequence of natural disasters, women and girls also face the risk of domestic violence and sexual assaults following disasters,¹⁰¹ particularly in temporary shelters or camps.¹⁰² These violent behaviours can be triggered by disaster-induced stress and economic anxieties. The risk of facing violence is likely to elevate after a natural disaster if women were already the victim of violence prior to the disaster.¹⁰³

Women’s vulnerability can be further exacerbated as support networks including family, friends and relevant government/non-government institutions to protect vulnerable women may not be accessible or functional in disaster situations.¹⁰⁴ Fear of violence may also drive women away from using shelters or camps,¹⁰⁵ which could exacerbate their vulnerability even further. Following the 2004 tsunami, for example, some young jobless women in Thailand were reported to have been subjected to the risk of forcible entry into sex work.¹⁰⁶

The 2010 Asia Pacific Disaster Report¹⁰⁷ elucidates the difference in the disaster-related mortality risk between men and women in Asia. For example, 61% of nearly 140,000 deaths caused by the 2008 cyclone in Myanmar were women. In the 1991 cyclone in Bangladesh that killed 140,000, women accounted for 90% of deaths¹⁰⁸ and they were nearly 4 times more likely to be killed as compared with men. During the 2004 Indian Ocean Tsunami, 70 to 80% of those killed were women. Although tsunami is not a climate-sensitive event, this figure, together with the other figures, strongly indicate the magnitude of greater mortality risk for women in natural disasters in Asia.

⁹⁴ Costello et al. 2009.

⁹⁵ WHO 2009b.

⁹⁶ Neumayer et al. 2007; WHO 2011a.

⁹⁷ Peterson 1997.

⁹⁸ Neumayer and Plümper 2007, cited in WHO 2011a.

⁹⁹ Araujo and Quesada-Aguilar 2007.

¹⁰⁰ ADB 1999.

¹⁰¹ Bartlett 2008, cited in WHO 2011a.

¹⁰² Brody et al. 2008.

¹⁰³ All India Disaster Mitigation Institute 2005, cited in WHO 2011a; International Federation of Red Cross and Red Crescent Societies 2007, cited in WHO 2011a.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.

¹⁰⁶ UNESCAP and UN International Strategies for Disaster Reduction 2010.

¹⁰⁷ Ibid.

¹⁰⁸ Aguilar 2004, cited in WHO 2011a.

In addition to women, girls at younger ages also appear to be particularly at a heightened risk of disaster-related mortality. In a 1993 flash flood that hit Nepal with a death toll of over 1,600, the flood-related fatality rate per 1,000 for girls and boys at the age of between 2 and 9 was 13.3 and 9.4, respectively.¹⁰⁹ The corresponding figures for adult women and men were 6.1 and 4.1, respectively.

A study that examined information from 147 countries demonstrated that gender differences in the disaster-related health risks are not likely attributable to physical differences between men and women.¹¹⁰ The 2009 UNFPA *State of World Population* concludes that the sex differences in disaster-related mortality are directly influenced by gender inequalities in the socioeconomic status and “the degree to which women enjoy economic and social rights.”¹¹¹ The report also affirms that in countries where men and women enjoy comparable status, natural disasters affect them almost equally.

Additionally, pregnant women are at an increased risk of malaria infection, which is climate-sensitive as described previously. In comparison to non-pregnant women, maternal women are at a 2-fold increased risk of malaria due to pregnancy-induced physiological changes.¹¹² Maternal malaria infection is associated with a number of complications, such as “spontaneous abortion, premature delivery, stillbirth and low birth weight.”¹¹³

4. Other population groups vulnerable to climate change impacts

Apart from women, other population groups with high vulnerability to climate change in the region include people living in (1) mountain communities, (2) deltaic regions, (3) coastal areas, and (4) urban slums.

Mountain communities are highly vulnerable to water scarcity, floods, landslides, rock avalanches, and infectious diseases triggered by climate change.¹¹⁴ Warmer climate increases the risk of vector-borne diseases such as malaria among mountain populations who do not have immunity against these diseases. Data show that the pace of temperature increase is faster at high altitudes.¹¹⁵

Glacier melting associated with climate change threatens the supply of fresh water for personal and agricultural use in mountain areas, thereby jeopardising their livelihoods, food security and health.¹¹⁶ Food insecurity is already a continuous problem among people in mountain communities in Nepal,¹¹⁷ and climate change could further aggravate the challenge.

¹⁰⁹ WHO 2010c.

¹¹⁰ Neumayer and Plümper 2007, cited in WHO 2011a.

¹¹¹ UNFPA 2009.

¹¹² WHO 2011a.

¹¹³ WHO 2011a.

¹¹⁴ WHO 2009b; WHO 2008a.

¹¹⁵ Liu and Chen 2000, cited in WHO 2008a.

¹¹⁶ WHO 2008a.

¹¹⁷ Eriksson et al. 2008.

By creating lakes, glacier melting also increases the risk of glacier lake outburst floods (GLOF), which are extremely deadly and destructive to downstream mountain communities,¹¹⁸ their food security and health. This is particularly concerning for the countries in the Himalayan region, such as Bhutan, China, India, Nepal and Pakistan.¹¹⁹ The health vulnerability of people in mountain areas is amplified even further for their limited access to public health systems.¹²⁰

Floods, sea level rise, and subsequent salinization of fresh water subject people in deltas, particularly in low-lying river deltas, as well as in coastal areas to health hazards such as disaster-related deaths, injuries, and food insecurity due to destruction of agricultural bases. Climate change is also believed to increase the level of cholera bacteria in waters in the coastal areas.¹²¹

In Bangladesh where over 120 million people live in the deltaic areas, it is estimated that a 10% land loss and 6 million displaced people would result from a 0.5m sea level rise.¹²² A 1.0m rise would lead to a 20% land loss and 15 million displaced people. According to another estimate, Bangladesh is projected to see a rise of up to 1.8m in sea level by the end of the 21st century, under the worst case scenario, losing up to 16% of its land that is supporting 13% of the Bangladeshi population,¹²³ or approximately 21 million.

The magnitude of large populations living in coastal areas in the Asia Pacific region can magnify public health vulnerability, risks and impacts of climate change. They may include disaster-related deaths and injuries, infectious disease outbreaks, loss of livelihoods, distress migration and destruction of critical public health-related infrastructure such as hospitals, clean water supply, sanitation and disposable systems. In Indonesia, nearly 61% of its population, or 110 million, live in coastal areas.¹²⁴ About 70% of Samoa's population and infrastructure are found in coastal areas.¹²⁵

Poor sanitation and waste disposal systems and lack of access to improved water in urban slum areas create high health risks among urban slum dwellers. A study, for example, demonstrated that poor people residing in slums in Jakarta are highly susceptible to floods.¹²⁶ In 2005, about 35% of the urban population in Asia and the Pacific were living in slums.¹²⁷ In some countries such as Bangladesh, Cambodia, the Lao People's Democratic Republic, Mongolia and Nepal, the figure was much higher, exceeding 50%.¹²⁸ UNESCAP estimates that the number of urban slum dwellers in the Asia Pacific region is approximately 571 million.¹²⁹

¹¹⁸ Bajracharya et al. 2008; Ives et al. 2010.

¹¹⁹ Ives et al. 2010.

¹²⁰ Eriksson et al. 2008.

¹²¹ UNFCCC 2007.

¹²² Houghton 2004, cited in Costello et al. 2009.

¹²³ Maslin 2008, cited in Costello et al. 2009.

¹²⁴ Staringa 2008.

¹²⁵ WHO 2008a.

¹²⁶ Firman et al. 2011.

¹²⁷ UNESCAP 2010.

¹²⁸ Ibid.

¹²⁹ Ibid.

Together with a growing urban slum population and its densities, urban slum dwellers are at a greater risk of tuberculosis as well as water-borne diseases such as diarrhoea and cholera in extreme climatic events such as flooding and heavy precipitation.¹³⁰ Additionally, heat island effect in urban areas can increase the risk of heat waves and heart strokes.¹³¹

5. Responses in the Asia-Pacific region

In response to real and potential health impacts of climate change, various recommendations have been made. They range from reduction of carbon emissions, more studies to strengthen evidence on health impacts of climate change, sensitisation of policy makers, establishment of effective disease surveillance and control to disaster preparedness, among others.¹³²

The WHO Regional Framework for Action to Protect Human Health from the Effects of Climate Change in Asia and the Pacific¹³³ highlights the following objectives and action points for governments:

(1) *Increase awareness of health consequences of climate change:*

- Undertake studies on the health implications of climate change and share information to understand how to promote changes in individual and corporate behaviours that mitigate climate-related health risks, while protecting and promoting health.
- Enhance political commitment and strengthen institutional capacity and arrangements to achieve adaptation and mitigation goals.
- Facilitate national working groups, nongovernmental organizations and civil society to develop coordinated mitigation and adaptation plans by including relevant sectors, regions and disciplines.
- Develop awareness-raising programmes and learning resource materials to educate and engage a broad range of stakeholder, including local communities, health and other relevant professionals, and the media on the potential health impacts of climate variability and change and on appropriate measures to reduce climate-sensitive risk factors and adverse health outcomes.

(2) *Strengthen the capacity of health systems to provide protection from climate-related risks and substantially reduce health system's greenhouse gas (GHG) emissions:*

- Develop and implement national action plans for health that are integrated into existing national plans on adaptation and mitigation to climate change.
- Develop integrated strategies to incorporate current and projected climate change risks into existing health policies, plans and programmes to control climate-sensitive health outcomes, including integrated vector management, and health risk management of disasters.
- Strengthen existing infrastructure and interventions, including human resource capacity, particularly surveillance, monitoring and response systems and risk

¹³⁰ Tupasi et al. 2000; UHRC 2007; WHO 2008c; Staringa 2008; WHO 2009b; Costello et al. 2009.

¹³¹ Costello et al. 2009.

¹³² Costello et al. 2009; WHO 2008a; Staringa 2008.

¹³³ WHO 2008a.

communication, to reduce the burden of climate-sensitive health outcomes. Key concerns vary by country; common concerns include vector borne diseases, air quality and food and water security.

- Strengthen public health systems and disaster/emergency preparedness and response activities, including psychosocial support, through increase collaboration and cooperation across sectors. This should include documentation, sharing and evaluation of the effectiveness of local knowledge and practices.
- Provide early warning systems to support prompt and effective responses to current and projected health burdens. In order to achieve this, national and regional climate forecasting information, including climate change projections, should be fully utilized.
- Implement adaptations over the short, medium or long term; be specific to local health determinants and outcomes of concern; and facilitate the development of community-based resource management. The costs and benefits of different interventions should be determined.
- Establish climate change focal points or mechanisms within national health institutions to ensure the implementation, monitoring and evaluation of health mitigation and adaptation actions and ensure that health issues are adequately addressed in these actions.
- Establish programmes through which the health sector substantially reduces GHG emissions; by doing so, it could also serve as a best practice model for other sectors.

(3) *To ensure that health concerns are addressed in decisions to reduce risks from climate change in other key sectors:*

- Develop integrated strategies to incorporate current and projected climate change risks into existing policies, legislation, strategies and measures of key development sectors to control climate-sensitive health outcomes. Examples include the promotion of public and non-motorized transportation, clean energy and disaster risk management.
- Facilitate the health sector to actively participate in national communications to the United Framework Convention on Climate Change (UNFCCC), and include health issues as the core elements in the negotiation process.
- Facilitate active health participation in the national climate change team.

It has been pointed out that international assistance has prioritised disaster recovery efforts over adaptive capacity development in developing countries.¹³⁴ Capacity building at local, regional and national levels could contribute simultaneously to improving surveillance, disaster preparedness, health-seeking behaviour in extreme climatic events, and, overall, sustainable resilience to the health risks and consequences of climate change in the long run.

Engagement of the community in collective efforts for adaptive capacity building is particularly considered critical.¹³⁵ Involvement of affected communities such as those mentioned in the previous section and especially women needs to be proactively

¹³⁴ Mizra 2003.

¹³⁵ Costello et al. 2009.

pursued, given their known high vulnerabilities to climate-sensitive health risks. The Commission on the Status of Women expressed in its 55th session in February 2011 that “[G]ender equality and the effective participation of women ... are important for effective action on all aspects of climate change.”¹³⁶

In response to growing awareness and evidence of climate-sensitive health risks, WHO and UNDP initiated in 2010 a project on public health adaptation to climate change.¹³⁷ It is the first global project to focus on strengthening adaptive capacity of country’s health systems including practitioners on the field to effectively address health risks associated with climate change. Seven countries were selected for this project, of which 3 are in the Asia-Pacific region: Bhutan, China and Fiji.

The goal of this project is to “increase adaptive capacity of national health system institutions, including field practitioners, to respond to climate sensitive health risks.”¹³⁸ The common objectives of the project include strengthening early warning and early action; capacity building of national stakeholders; piloting risk reduction interventions on specific health issues; and documentation and sharing of lessons learned.

Within these overarching common objectives, there are also country-specific objectives.¹³⁹ The project in Bhutan, for example, focuses the following areas: (1) strengthening metrological and surveillance systems to provide evidence on climate-sensitive health outcomes for awareness and action; (2) enhancing human and financial resources to address climate change risks in health activities; (3) integrating climate change concerns into ongoing relevant health programmes such as the National Vector-borne Disease Control Program; and (4) improving coordination among climate and health initiatives. The project is expected to increase awareness and capacity of health professionals and the community to better respond to climate-related health risks and impact mitigation.

National governments in the Asia-Pacific region are also taking action. For example, many countries in the region have already developed the National Adaptation Programme of Action (NAPA).¹⁴⁰ NAPA focuses on strengthening adaptive capacity of least developing countries (LDCs) to climate change and its impacts and helps them prioritise their action based upon their needs and interests. It is submitted to the secretariat of UNFCCC, which qualifies the country to apply for funding from the LDC Fund (LDCF) of the Global Environment Facility to implement NAPA. Therefore, NAPA serves as the backbone of a country’s response for climate change adaptation.

Nepal, for example, submitted its NAPA in late 2010.¹⁴¹ It provides a comprehensive assessment of the country’s climate change adaptation situation, needs, challenges and strategies in areas of priority. It covers agriculture and food security, water resources and energy, climate-induced disasters, forests and biodiversity, public health, and urban

¹³⁶ UNECOSOC 2011.

¹³⁷ WHO n.d.-b.

¹³⁸ UNDP and WHO 2010.

¹³⁹ UNDP and WHO n.d.

¹⁴⁰ UNFCCC 2011a.

¹⁴¹ Government of Nepal 2010.

settlements and infrastructure, all of which have health implications. There are proposed activities for each of these priority areas.

Proposed activities for adapting to climate challenges in public health in Nepal, budgeted at USD 15 million, include the following: (1) reducing public health impacts of climate change through evidence based research and piloting; (2) empowering communities through public education for responding adverse effects of climate change in public health; (3) investigating disease outbreak and emergency response; (4) scaling up programmes on vector borne, water and food borne diseases and disasters; and (5) strengthening forecasting/early warning and surveillance system on climate change and health.

Under the LCDF, projects on climate change adaptation with strong health implications have been implemented in many countries in the Asia Pacific region, often executed by the Ministry of Environment or other relevant ministries. These include Afghanistan (*Building adaptive capacity and resilience to climate change*); Bangladesh (*Community-based adaptation to climate change through coastal afforestation*); Bhutan (*Reducing climate change-induced risks and vulnerabilities from glacial lake outbursts*); Cambodia (*Vulnerability assessment and adaptation programme for climate change within coastal zone of Cambodia considering livelihood improvement and ecosystems*); Kiribati (*Increasing resilience to climate variability and hazards*); Lao PDR (*Improving the resilience of the agricultural sector in Lao PDR to climate change impacts*); Maldives (*Integration of climate change risks into the Maldives safer island development programme*); Samoa (*Integrated climate change adaptation in Samoa*); Tuvalu (*Increasing resilience of coastal areas and community settlements to climate change*); and Vanuatu (*Increasing resilience to climate change and natural hazards*).¹⁴² One of the key concerns in responding to the health impact of climate change is financial requirements. Additional disease and financial burdens attributable to climate change could overwhelm already over-stretched health systems in many countries in Asia and the Pacific. In Bangladesh, for example, the cost of treating *additional* cases of diseases due to climate change was estimated to be USD 2.8 billion, which is equivalent to 3% of its GDP.¹⁴³ The diseases included in this estimation are diarrhoea, kalazar, filarisis, dengue, malaria, and chikungunya, chronic obstructive pulmonary disease, injuries, drowning, malnutrition and other diseases and events. In response to these projected additional health and financial burdens, the Bangladeshi government is taking action to reduce people's vulnerabilities, by developing a new health care delivery system and reinvigorating primary health care services.¹⁴⁴

¹⁴² UNFCCC 2011b.

¹⁴³ WHO and PAHO 2010.

¹⁴⁴ Ibid.

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