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Climate change and urban children: impacts and implications for adaptation in low- and middle-income countries

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1. This paper is a summary of a longer, more detailed working paper. See Bartlett, Sheridan (2008), "Climate change and urban children: impacts and implications for adaptation in low- and middle-income countries", Human Settlements Discussion Paper Series, Climate Change and Cities 2, IIED, London.

2. Wilbanks, Tom and Patricia Romero Lankao with Manzhou Bao, Frans Berkhout, Sandy Cairncross, Jean-Paul Ceron, Manmohan Kapshe, Robert Muir-Wood and Ricardo Zapata-Marti (2007), "Industry, settlement and society", Chapter 7 in Martin Parry, Osvaldo Canziani, Jean Palutikof, Paul van der Linden and Clair Hanson (editors), *Climate Change*

ABSTRACT This paper discusses the particular and disproportionate risks to urban children in poverty from various aspects of climate change, both extreme events and changing means. It explores the potential impacts on children's health, learning and psychosocial well-being, and considers the implications of family coping strategies for children. The paper goes on to discuss the implications for adaptation, making recommendations for an adaptation agenda that focuses on the realities for children. Preparatory measures are considered, as well as responses to extreme events and to changes in weather patterns.

KEYWORDS adaptation / children / climate change / impacts / urban

I. INTRODUCTION

There are many vulnerable populations in the context of climate change – the impacts are not spread equally in terms of either location, economic status, gender or age. This paper discusses the particular and often disproportionate risks to urban children in poverty from various aspects of climate change. It also explores the implications for adaptation, focusing on preparatory measures as well as responses to extreme events and to changes in weather patterns.⁽¹⁾

Over the last 25 years, extreme weather events, including heavy rainfall, heat waves, droughts, floods, cyclones and hurricanes, have contributed to injury, illness, impoverishment, displacement, hunger and death for hundreds of millions of people, often with particular implications for children. Climate change is likely to have been a factor in many of these, but even if it was not, it is proof of the vulnerability of populations to events whose frequency and intensity is likely to increase in most places as a result of climate change. Climate change is also bringing higher temperatures, sea-level rise for all coastal cities and reductions in freshwater availability in many locations.⁽²⁾ Even if an effective international agreement is reached soon on reducing greenhouse gas emissions sufficiently to slow and then stop global warming, much of the world's population will still face these changes over the next few decades because of the time-lag in the world's climate system. Attention to adaptation is as urgently needed as attention to mitigation.

Why children? Children, especially young children, are in a stage of rapid development and are less well equipped on many fronts to deal

with deprivation and stress.⁽³⁾ Their more rapid metabolisms, immature organs and nervous systems, developing cognition, limited experience and behavioural characteristics are all at issue here. In addition, their exposure to various risks is more likely to have long-term repercussions than with adults. Adaptations to climate change will be less than adequate in responding to the challenges if they fail to take account of both the particular vulnerabilities of children and the protective factors that can best support their resilience.

Almost all the disproportionate implications for children are intensified by poverty and the difficult choices low-income households make as they adapt to more challenging conditions. Events that might have little or no effect on children in high-income countries and communities can have critical implications for children in poverty. The likelihood of poor outcomes increases cumulatively with the number of risks that they face, whether physiological or psychological.⁽⁴⁾ Children on the edge, like families on the edge, have fewer assets to draw on in every sense of the word, and are more likely to be adversely affected by the various challenges imposed by climate change. In poor urban areas, these links can be especially striking.

Why urban children? Urban children are generally better off than their rural counterparts, but this is not true for the hundreds of millions living in urban poverty. Without adequate planning and good governance, poor urban areas can be among the world's most life-threatening environments.⁽⁵⁾ In some informal settlements, a quarter of all children still die before the age of five.⁽⁶⁾ Nor does the "urban advantage" come into play in terms of education and life opportunities – the failure to complete, or even start, primary education is especially high among the urban poor, and prospects of upward mobility can be dim.⁽⁷⁾ In many urban areas, the risks children face are bound to be intensified by climate change. Most of the people and enterprises at most serious risk from extreme weather events and rising sea levels are located in urban slums in low-income countries, which are often in the most hazardous areas – flood plains or other areas at risk of floods, places at risk from landslides, sites close to industrial wastes, and areas unserved by the kind of infrastructure that can be strengthened and adapted to withstand more extreme conditions.⁽⁸⁾ Although the urban poor are at highest risk of loss and harm, they are the least able to afford preventive measures and the least likely to have their needs for risk reduction taken seriously by local governments.

Children as resilient, active agents. Despite children's disproportionate vulnerability on many fronts, it is an oversimplification to think of them only as victims in the face of climate change. With adequate support and protection, children can also be extraordinarily resilient in the face of stresses and shocks. There is ample documentation, moreover, of the benefits of having older children active, informed and involved in responding to the challenges in their lives, not only for their own learning and development, but for the energy, resourcefulness and knowledge that they can bring to local issues.⁽⁹⁾

An adaptation agenda with children in mind. It is increasingly recognized that effective adaptation to climate change in urban areas must address the development needs of the urban poor.⁽¹⁰⁾ An adaptation agenda developed with children in mind broadens the terms of this discussion. Where infrastructure and basic services are concerned, for instance, it means taking account of the ways these affect children and

2007: *Impacts, Adaptation and Vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York, pages 357–390.

3. Engle, P, S Castle and P Menon (1996), "Child development: vulnerability and resilience", *Social Science and Medicine* Vol 43, No 5, pages 621–635.

4. See, for instance, Evans, Gary W and Kimberly English (2002), "The environment of poverty: multiple stress exposure, psychophysiological stress and socioemotional adjustment", *Child Development* Vol 73, No 4, pages 1238–1248; also Werner, E and R Smith (1992), *Overcoming the Odds: High Risk Children from Birth to Adulthood*, Cornell University Press Ithaca, NY and London for classic research exploring resilience longitudinally in a cohort of children in Hawaii.

5. See, for instance, Van den Poel, E, O O'Donnell and E Van Doorslaer (2007), "Are urban children really healthier? Evidence from 47 developing countries", *Social Science and Medicine* Vol 65, No 10, pages 1986–2003.

6. In Nairobi, for example, figures for 2002 show mortality rates of 62 per thousand for children under five, as compared to 113 per thousand for Kenya's rural areas. Within the city's informal settlements, this rate rises to 151 per thousand and in the Embakasi slum, to 254 per thousand – four times as high as for the city as a whole. See APHRC (2002), *Population and Health Dynamics in Nairobi's Informal Settlements*, African Population and Health Research Centre, Nairobi.

7. A recent case study of rickshaw pullers in Dhaka, for instance, shows that the adult children of these first generation migrants were scarcely better educated than their fathers – 55 per cent had

never attended school at all and only a small number were functionally literate. School attendance rates generally in Dhaka are only 58 per cent, as compared to 73 per cent for villages. See Begum, Sharifa and Binayak Sen (2005), "Pulling rickshaws in the city of Dhaka: a way out of poverty?", *Environment and Urbanization* Vol 17, No 2, October, pages 11–26.

8. Satterthwaite, David, Saleemul Huq, Mark Pelling, Hannah Reid and Patricia Romero Lankao (2007), "Adapting to climate change in urban areas: the possibilities and constraints in low- and middle-income nations", Human Settlements Discussion Paper Series, Climate Change and Cities 1, IIED, London.

9. A well-known overview of children's capacities in this regard is Hart, R (1997), *Children's Participation: The Theory and Practice of Involving Young Citizens in Community Development and Environmental Care*, Earthscan/UNICEF, London.

10. See reference 8.

11. Bronfenbrenner, U (1979), *The Ecology of Human Development: Experiments by Nature and Design*, Harvard University Press, Cambridge, Mass.

12. Prüss-Üstün, A and C Corvalán (2006), *Preventing Disease through Healthy Environments. Towards an Estimate of the Environmental Burden of Disease*, WHO, Geneva.

13. Pradhan, Elizabeth Kimbrough, Keith P West, Joanne Katz, Steven C LeClerq, Subarna K Khatri and Sharada Ram Shrestha (2007), "Risk of flood-related mortality in Nepal", *Disasters* Vol 31, No 1, pages 57–70.

14. Nishikiori, N, T Abe, D G M Costa, S D Dharmaratne, O Kunii and K Moji (2006), "Who died as a result of the tsunami? Risk factors of mortality among internally displaced persons in Sri Lanka: a retrospective cohort analysis", *BMC Public Health* No 6, page 7.

those who care for them. For example, upgrading a road so that it is not washed away by flooding means considering the increased and more rapid traffic that will be generated, and the effects for children playing or walking to school.

The issues go well beyond infrastructure, however. The lack of attention to children reflects a generally lower level of attention to the human implications of climate change – as compared to the environmental and economic implications. Theory and practice regarding children have long stressed the importance of an integrated approach to development and well-being,⁽¹¹⁾ and this could well be more broadly applied. Adaptation, in these terms, means considering how to strengthen and support children's capacity to cope with the full range of risks and adversity associated with climate change, as well as that of the families and communities on which they depend.

II. UNDERSTANDING THE IMPACTS ON CHILDREN OF CLIMATE CHANGE

There is not enough knowledge about the implications of climate change for children to present a comprehensive picture. Even where there are projections for more general impacts, figures are seldom disaggregated by population group or age. However, it is possible to extrapolate from existing knowledge in related areas. Work on environmental health in urban areas, on disaster responses and household coping strategies, on the range of effects of urban poverty on children, the resilience of children and the beneficial effects of their participation in various efforts, all contribute to a picture of the implications of disasters and responses to disasters, as well as more gradual change and the adaptations likely to be made to them. Table 1 provides an overview of likely changes in climate, and their probable impacts on natural and human systems.

a. Health and survival

The disproportionate health burden for children of challenging environmental conditions is well documented. According to the most conservative estimates, children under 14 are 44 per cent more likely to die because of environmental factors than the population at large. The same gap exists for morbidity, and it increases greatly when the potential loss of healthy life years is considered.⁽¹²⁾ The greater burden, especially for the youngest children, then, is not a minor matter of degree, and it is likely to be exacerbated in many places by climate change.

Mortality related to extreme weather events. Small children, along with women and the elderly, are most likely to be victims of such extreme events as flooding, high winds and landslides. A study of flood-related mortality in Nepal, for instance, found the death rate for children to be double that of adults, with pre-school girls five times more likely to die than adult men. Poor households were at six times higher risk than their better-off neighbours.⁽¹³⁾ The distribution of deaths related to the 2004 Indian Ocean tsunami followed a similar pattern, as shown in Figure 1.⁽¹⁴⁾

In slower onset disasters such as droughts and famines, mortality rates are also more extreme for young children. A situation such as this is

TABLE 1
Some likely impacts of climate change

Change	Impact on natural systems, agriculture, water	Impact on urban areas	Impact on health and household coping	Implications for children
Warm spells and heat waves: frequency up in most land areas	Reduced crop yields in warmer regions; increased risk of wildfire; wider range for disease vectors.	Heat islands with higher temperatures (up to 10° higher); often large concentrations of vulnerable people; air pollution worsens.	Increased risk of heat-related mortality and morbidity; more vector-borne diseases; impact on those doing strenuous labour; increase in respiratory diseases where air pollution worsens; food shortages.	Greatest vulnerability to heat stress for young children; high vulnerability to respiratory diseases and vector-borne diseases; highest vulnerability to malnutrition, with long-term implications.
Heavy precipitation events: frequency up over most areas	Damage to crops; soil erosion; waterlogging; water quality problems.	Increased risk of floods and landslides; disruption to livelihoods and city economies; damage to homes, possessions and businesses, and to transport and infra-structure; loss of income and assets; often large displacements of population, with risks to social networks and assets.	Deaths and injuries; increase in food-borne, and water-borne and water-washed diseases; more malaria from standing water; decreased mobility, with implications for livelihoods; dislocations; food shortages; risks to mental health, especially associated with displacement.	Higher risk of death and injury than for adults; more vulnerable to water-borne and water-washed diseases and to malaria; risk of acute malnutrition; reduced options for play and social interaction; likelihood of being removed from school /put to work, as income is lost; higher risk of neglect, abuse and maltreatment associated with household stress and/or displacement and long-term risks for development and future prospects.
Intense tropical cyclone activity increases	Damage to crops, trees and coral reefs; disruption to water supplies.	Water shortages; distress migration to urban centres; hydroelectric constraints; lower rural demand for goods/services; higher food prices.	Increased food and water shortages; increased malnutrition and food and water-borne diseases; increased risk of mental health problems; respiratory problems from wildfires.	Young children at highest health risk from inadequate water supplies; at highest risk of malnutrition, with long-term implications for overall development; risk of early entry into work; exploitation.
Increased area affected by drought	Land degradation; lower crop yields; livestock deaths; increased risk of wildfire and water stress.	Loss of property and enterprises; damage to tourism; damage to buildings from rising water table.	Coastal flooding; increased risk of death and injury; loss of livelihoods; health problems from salinated water.	Highest rates of death for children; highest health risks from salinization of water supplies; long-term developmental implications.
Increased incidence of extreme high sea level	Salinization of water sources.			

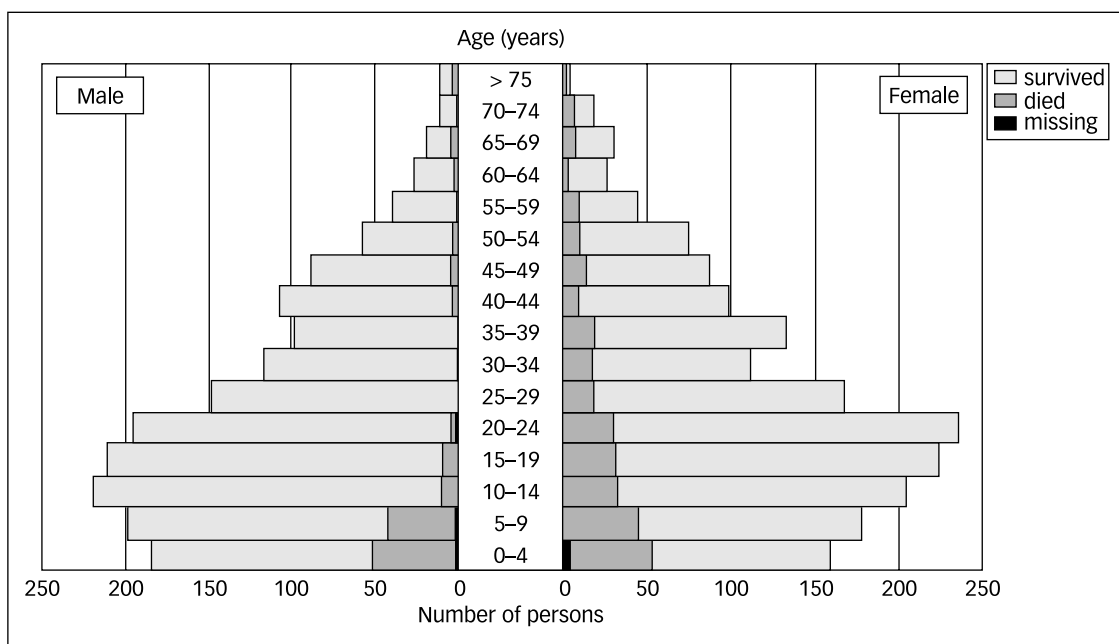


FIGURE 1
Age and gender distribution of tsunami-related deaths in Sri Lanka

SOURCE: Nishikiori, N, T Abe, D G M Costa, S D Dharmaratne, O Kunii and K Moji (2006), "Who died as a result of the tsunami? Risk factors of mortality among internally displaced persons in Sri Lanka: a retrospective cohort analysis", *BMC Public Health* No 6, page 7.

15. Sphere Project (2004), "Humanitarian charter and minimum standards in disaster response", accessible at www.sphereproject.org/.

16. United Nations Children's Fund (2007), *The State of the World's Children*, UNICEF, New York.

17. Murray, C J and A D Lopez (1996), *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries and Risk Factors in 1990 and Projected to 2020*, Harvard University Press, Boston.

18. Bartlett, S (2003), "Water, sanitation and urban children: the need to go beyond 'improved' provision", *Environment and Urbanization* Vol 15, No 2, October, pages 57-70.

commonly defined as an emergency when crude mortality is one per 10,000 per day, and under-five mortality is double that.⁽¹⁵⁾ This much higher rate for young children is not a departure from the norm in low-income countries,⁽¹⁶⁾ but it still highlights a dismal reality – that higher mortality rates for young children, unthinkable in high-income countries, should be so routinely accepted as a baseline indicator of normality. Overall death rates for young children continue to drop in most parts of the world due to improved health care, immunization rates and environmental conditions. But for many of the children most at risk from the biggest killers – diarrhoeal and respiratory diseases, malaria and malnutrition – the situation is likely to worsen with some of the effects of climate change.

Water and sanitation-related illnesses. Inadequate access to clean water and proper sanitation increases the risk of a range of health problems. Globally, children under five are the victims of 80 per cent of sanitation-related illnesses and diarrhoeal disease, primarily⁽¹⁷⁾ because of their less-developed immunity and because their play behaviour can bring them into contact with pathogens. Diarrhoeal disease also results in higher levels of malnutrition and increased vulnerability to other illnesses, with effects on overall development.⁽¹⁸⁾

Various conditions associated with climate change are likely to result in increased risks for young children. After extreme events, diarrhoeal illnesses related to breakdowns in piped water supplies and sanitation can

take more lives than the initial disaster.⁽¹⁹⁾ The risks in underserved urban settlements also increase with “minor” events. During heavy or prolonged rains, blocked drains and flooded latrines can make contamination difficult to avoid, increasing the incidence of diarrhoeal illness in children.⁽²⁰⁾ Where the incidence and duration of rainstorms increases because of climate change, these conditions will become more prevalent.

Contamination of water supplies is also a risk during droughts. For small children’s health, water quantity is generally considered even more important than its quality.⁽²¹⁾ Unwashed hands, food, utensils, floors and cooking surfaces all contribute to higher levels of endemic illness. When water must be fetched from a distance, or when supplies are low or erratic, households make do with less than necessary to meet children’s routine health needs.⁽²²⁾ When they store water, the potential for contamination goes up. In a poor neighbourhood in Abidjan, Côte d’Ivoire, for instance, *E. coli* was found in only one per cent of water samples taken at the community source, but in 41 per cent of samples that had been stored at home.⁽²³⁾ The IPCC projects that climate change will increase the burden of diarrhoeal disease in low-income countries by approximately 2–5 per cent by 2020.⁽²⁴⁾

Malnutrition. Malnutrition is related to food shortages resulting from reduced rainfall and other changing means that affect agriculture; also to interruptions in food supplies in sudden, acute events. Children in Africa born in drought years, for example, are significantly more likely to be malnourished or stunted (in Kenya, 50 per cent more likely to be malnourished, and in Niger, 72 per cent more likely to be stunted).⁽²⁵⁾

But malnutrition is also closely tied to unsanitary conditions and to children’s general state of health. Frequent bouts of diarrhoea and infestations of worms, for instance, mean impaired absorption and a loss of nutrients. When children are malnourished, their vulnerability to infection is greatly increased and a vicious cycle results.⁽²⁶⁾ A chronically malnourished three or four year-old may be at a permanent disadvantage, becoming both physically and mentally stunted.⁽²⁷⁾

Nutritional risk as a result of disasters tends to be low if children were previously well nourished⁽²⁸⁾ and if the acute malnutrition associated with the event does not go on for too long. After Bangladesh’s 1998 floods, when families were unable to compensate over time for the shortage of food and the deterioration in health conditions, flood-exposed children failed to experience the “catch-up” growth common after a shock, remaining shorter than unexposed children from the same neighbourhoods.⁽²⁹⁾ Similarly significant impacts on children’s growth were found in Zimbabwe following a drought, in this case over a much longer term. Children in the critical 12–24 month-old age group during the drought in the early 1980s were found 13 to 16 years later to have had an average loss of stature of 2.3 inches. Their potential loss in life time earnings was calculated to be 14 per cent.⁽³⁰⁾ Malnutrition appears to be a greater risk among children of displaced families.⁽³¹⁾ This may be related to the poor levels of sanitation in many temporary shelters as well as to the effects of displacement on household coping strategies. Infants are at particular risk. Stresses related to a crisis may affect mothers’ breast milk production; at the same time, breast milk substitutes present a serious health risk in unsanitary environments.⁽³²⁾

Vector-borne and infectious diseases. Increased temperatures and changes in precipitation are increasing the incidence and range of various

19. WHO, www.who.int/entity/ceh/indicators/0_14disasterareas.pdf, downloaded 15 October 2007.

20. See, for instance, Moraes, L R, J A Cancio, S Cairncross and S Huttly (2003), “Impact of drainage and sewerage on diarrhoea in poor urban areas in Salvador, Brazil”, *Transactions of the Royal Society of Tropical Medicine and Hygiene* Vol 97, No 2, pages 153–158.

21. Shi, A (2000), *How Access to Urban Potable Water and Sewerage Connections Affects Child Mortality*, Development Research Group, World Bank, Washington DC.

22. Victoria, C G et al. (1988), “Water supply, sanitation and housing in relation to the risk of infant mortality from diarrhoea”, *International Journal of Epidemiology* Vol 17, No 3, pages 651–654; also Curtis, V, B Kanki et al. (1995), “Potties, pits and pipes: explaining hygiene behaviour in Burkino Faso”, *Social Science and Medicine* Vol 41, No 3, pages 383–393.

23. Dunne, E F, H Angoran-Benie et al. (2001), “Is drinking water in Abidjan, Côte d’Ivoire, safe for infant formula?”, *Journal of Acquired Immune Deficiency Syndrome* Vol 28, No 4, pages 393–398.

24. Confalonieri, U, B Menne, R Akhtar, K Ebi, M Hauengue, R S Kovats, B Revich and A Woodward (2007), “Human health”, Chapter 8 in Parry et al., see reference 2, pages 391–431.

25. UNDP (2007), *Human Development Report 2007/2008*, Palgrave Macmillan, New York.

26. Lechtig, A and B Doyle (1996), “The impact of water and sanitation on malnutrition and under-five mortality rates”, *WATERfront* Vol 8, pages 5–19.

27. Grantham-McGregor, S, Y B Cheung, S Cueto, P Glewwe, L Richter and B Strupp (2006), “Developmental potential in the first five years for children in developing countries”, *The Lancet* Vol 369, pages 60–70.

28. Magkos, F, F Arvaniti, I Piperkou, S Katsigaraki, K Stamatelopoulos, M Sitara and A Zampelas (2004), "Identifying nutritionally vulnerable groups in case of emergencies: experience from the Athens 1999 earthquake", *International Journal of Food Sciences and Nutrition* Vol 55, No 7, pages 527–536.

29. Del Ninno, Carlo and Matthias Lundberg (2005), "The long-term impact of the 1998 flood on nutrition in Bangladesh", *Economics and Human Biology* Vol 3, No 1, pages 67–96.

30. Alderman, H, J Hoddinott and B Kinsey (2004), "Long-term consequences of early childhood malnutrition", Mimeo, Department of Economics, Dalhousie University, Halifax, Canada.

31. See, for instance, Jayatissa R, A Bekele, C L Piyasena and S Mahamithawa (2006), "Assessment of nutritional status of children under five years of age, pregnant women and lactating women living in relief camps after the tsunami in Sri Lanka", *Food and Nutrition Bulletin* Vol 27, No 2, pages 144–152; also Barrios, R E, J P Stansbury, R Palencia and M T Medina (2000), "Nutritional status of children under five years of age in three hurricane-affected areas of Honduras", *Revista Panamericana de Salud Pública* Vol 8, No 6, pages 380–384.

32. Caldwell, Pat (1996), "Child survival: physical vulnerability and resilience in adversity in the European past and the contemporary third world", *Social Science and Medicine* Vol 43, No 5, pages 609–619; also IFE Core Group (2006), "Infant and young child feeding in emergencies: operational guidelines for emergency relief staff and programme managers", available from <http://enonline.net>.

33. Bunyavanich, Supinda, Christopher P Landrigan, Anthony J McMichael and Paul R Epstein (2003), "The impact of climate change on child health", *Ambulatory Pediatrics* Vol 3, pages 44–52; also Ligon, B L (2006), "Infectious

vector-borne diseases, and with it the level of exposure, with particular implications for children.⁽³³⁾

The most serious threat is malaria. Fifty per cent of the world's population is now considered to be at risk, a 10 per cent increase in the last decade.⁽³⁴⁾ More than 90 per cent of the burden is in Africa, where 65 per cent of mortality is among children under five.⁽³⁵⁾ These numbers alone fail to capture the full implications for children. Malaria results in chronic anaemia, increases the severity of other diseases and more than doubles the mortality rates for children under five.⁽³⁶⁾ It contributes to impaired development in some children because of the insult to the brain during acute episodes, but this is also mediated by the effects of anaemia, repeated illness and undernutrition related to the disease.⁽³⁷⁾

Treatment measures are seldom adequate. A survey in Kampala, Uganda, found that children in 36 per cent of surveyed households had experienced fever in the previous two weeks, but less than one per cent received the recommended medical treatment despite the proximity of clinics and hospital. Only 11 per cent of households (the wealthiest) used treated nets.⁽³⁸⁾ Even this is high for Africa, where a multi-country survey found that treated nets were used by only 2 per cent of households with children under five.⁽³⁹⁾

Respiratory illnesses. Respiratory illnesses cause 20 per cent of under-five deaths worldwide. A number of factors are involved, not all affected by climate change. However, changes in mean temperature and precipitation can increase the number of forest and bush fires, which affect air quality for thousands of miles, generally increasing the number of people experiencing respiratory difficulties.⁽⁴⁰⁾ Changing pollen counts, fungal growth and moulds related to flooding, and increases in ozone and other pollutants also increase rates of pneumonia, upper respiratory diseases and asthma. Asthma has doubled worldwide over the last 15 years, with the greatest increases among children,⁽⁴¹⁾ and asthma deaths are expected to increase by 20 per cent by 2016.⁽⁴²⁾ Factors affecting the prevalence or severity of respiratory ailments are far from clear, however – the variables are too numerous.⁽⁴³⁾ Nor are children always those most affected.⁽⁴⁴⁾

Heat stress. Those most at risk from increasingly frequent and intense heat waves are the elderly and the very young, who sweat less and have more surface area relative to body mass.⁽⁴⁵⁾ Research in São Paulo found a 2.6 per cent increase in mortality rates in children under 15 for every degree increase above 20°C – similar to the increase for those over the age of 65 (2.5 per cent).⁽⁴⁶⁾ For younger children, this increase is likely to be higher. The impact is most serious in cities, where the urban "heat island" effect can mean differences of as much as 10°C between the city and surrounding areas.⁽⁴⁷⁾ Temperatures vary between neighbourhoods, with poorer groups more likely to live where temperatures are higher due to higher densities and less vegetation and open space.⁽⁴⁸⁾

Injury. Children are particularly susceptible to injury – curious and driven to explore, yet lacking the capacity to understand and respond well to danger. Falls and burns, along with drowning, disproportionately affect children under five.⁽⁴⁹⁾ Children also experience more serious, long-term effects from burns, fractures, head injuries and poisoning because of their size and physiological immaturity.⁽⁵⁰⁾ Injury rates are related to challenging conditions, overcrowding, complexity in the environment and higher levels of preoccupation on the part of adults⁽⁵¹⁾ – all factors

commonly experienced in the post-disaster context as well as in the context of gradually worsening conditions.

The quality of care. As changes in extremes and means create conditions that are more challenging to health, this also affects the burdens faced by caregivers. These problems are seldom faced one at a time. When inadequate water supplies are compounded by a lack of sanitation, overcrowded living quarters and an absence of safe play space, the difficulties can become overwhelming. Overstretched and exhausted caregivers are more likely to leave children unsupervised and to cut corners in all the chores that are necessary for healthy living, with potentially serious implications for children's health.

b. Learning and competence

For some children in some places, the challenges related to climate change could contribute to an erosion of both their mental capacity and their opportunities for learning and growth. The early years are the most critical time for brain development, which can be shaped by a range of environmental factors.⁽⁵²⁾ Good health is central, as sick or malnourished children lack the energy to be active learners.⁽⁵³⁾ Abundant research relates lower cognitive capacity and performance to undernutrition;⁽⁵⁴⁾ and behaviour and social relationships may also be affected.⁽⁵⁵⁾ The lack of specific nutrients such as iodine, iron or zinc, related to accessibility of certain foods, also hampers development.⁽⁵⁶⁾ Children's mental growth can be affected also by intestinal parasites, diarrhoeal disease and malaria,⁽⁵⁷⁾ all factors, as noted, that can be expected to increase with climate change. Maternal health, nutrition and stress levels during pregnancy are also related to children's lower cognitive performance and language ability later on.⁽⁵⁸⁾

Children's learning also depends on supportive social and physical environments. Their development of new skills and capacities takes place within a social and cultural context that is structured to help them acquire the experiences and competencies that they need to live their lives.⁽⁵⁹⁾ When young children lack easy access to social interaction and to safe, varied, stimulating surroundings for play, this can affect their development as capable problem solvers and social beings.⁽⁶⁰⁾ Not all stimulation is positive for learning, however. High levels of noise and crowding and a lack of physical and temporal structure in daily life have been found consistently to have negative impacts on children's development, distracting their attention and affecting the quality of interactions with adults.⁽⁶¹⁾ This is an accurate description of many post-disaster settings, where children may live for months on end in overcrowded emergency camps. Challenging events on a much smaller scale can also disrupt life repeatedly, diminishing the positive supports available to children and putting a damper on play and exploration.

For older children and also adolescents, opportunities for purposeful goal-directed activities and engagement in the world are primary avenues for the achievement of competence.⁽⁶²⁾ In the course of displacement, or in the disruption of routines and local environments that can accompany even "minor" disasters, these opportunities, however minimal they may be, and whether formal or informal, can become seriously constrained. Schooling is an issue. After extreme weather events, schools may be

diseases that pose specific challenges after natural disasters: a review", *Seminars in Pediatric Infectious Diseases* Vol 17, No 1, pages 36–45; and Kovats, R S and Rais Akhtar (2008), "Climate, climate change and human health in Asian cities", *Environment and Urbanization* Vol 20, No 1, April, pages 165–176.

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35. See reference 34.

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destroyed, damaged, shut down or taken over as emergency shelters for weeks or even months.⁽⁶³⁾ Even when schools stay open, children may be pulled out because of displacement or because their disaster-affected families lack the resources for them to attend. Conditions for displaced children may also make it difficult to do homework, increasing the likelihood of their dropping out.⁽⁶⁴⁾

c. The capacity to cope with adversity

The shock and distress of extreme events, as well as the deprivations and humiliations of displacement or slow recovery, can be profoundly debilitating. Children's psychological vulnerability and resilience in the face of hardship depend on their health and internal strengths, but also on household dynamics and levels of social support.⁽⁶⁵⁾ Age is just one of many factors mediating the experience of adversity: some children may actually be more resilient than their elders,⁽⁶⁶⁾ but their lack of social power within family and community can also leave them especially vulnerable to hardship. Children who have experienced success and approval in their lives are more likely to adapt well. Poverty and social status can play an important role in this regard. For older children, the effects of events on their social world and peer relationships are highly significant.⁽⁶⁷⁾ But without question, there can be numerous assaults on children's resilience after extreme events.

Especially in low-income countries, children may end up orphaned or separated from family. Extended family or other community members can provide a secure alternative, but too often even these bonds are frayed to breaking point, and extra children can become a target for mistreatment.⁽⁶⁸⁾ Even where families remain intact, however, picking up the pieces can be extremely challenging. Basic requirements may be hard to come by, livelihoods may have disappeared, relief may be inequitably distributed, and community life and social supports may have collapsed. The disruption of play, school, daily chores, livelihoods and other familiar activities can leave children and adults more vulnerable to distress. Increased levels of irritability, withdrawal and family conflict are not unusual after disasters.⁽⁶⁹⁾ High stress for adults can have serious implications for children, contributing to neglect and even abuse.⁽⁷⁰⁾ Increased rates of child abuse have long been associated with factors that can become more prevalent after disaster or household upheaval – such as maternal depression, loss of property or a breakdown in social support. In the United States, for instance, hospital records revealed that rates of traumatic brain injury inflicted on small children increased more than five-fold in the six months following a severe hurricane when compared to the previous six months.⁽⁷¹⁾ Children's anxious behaviour after disasters could contribute to abusive responses. Bed wetting, nightmares, aggressiveness or clinging behaviour can add to the stresses of parents attempting to deal with disaster-related problems.⁽⁷²⁾ Resilience in children in adversity has been related repeatedly in part to the presence of at least one actively supportive adult in their lives.⁽⁷³⁾ Even this can be hard to come by when adults are withdrawn and depressed, or angry and frustrated.

Displacement and life in emergency or transitional housing have been noted in many contexts to lead to an erosion of the social controls

that normally regulate behaviour within households and communities. Overcrowding, chaotic conditions, a lack of privacy and the collapse of regular routines can contribute to anger, frustration and violence.⁽⁷⁴⁾ Sexual violence is commonly reported.⁽⁷⁵⁾ There have been numerous accounts of children and women enduring abuse of various kinds. Adolescent girls in particular complain of the lack of privacy around sleep, washing and dressing, and of the sexual harassment they face.⁽⁷⁶⁾ The synergistic effects of such accumulated physical and social stressors have been found to affect children's development on all fronts.⁽⁷⁷⁾ As the numbers of displaced people grow, these dysfunctional environments are likely to become the setting within which more and more children spend their early years.

Disasters and long-term displacement are not unique, however, in terms of the stress they create. Even less extreme events can create havoc in people's lives, deepening the level of poverty – whether through short-term displacement, loss of work, reductions in food security, rising prices for basics, or just the time and energy drain associated with more challenging conditions. As Diagne describes in St Louis, Senegal: “*For those who live in flood-prone districts, each flood increases their poverty, depleting their incomes and meagre asset bases.*”⁽⁷⁸⁾ The report from an African workshop points out that in the continuum between large-scale disasters and everyday hazards, it is the smaller-scale but more frequent events that cumulatively take the greatest toll on life, livelihoods and household well-being in many urban areas.⁽⁷⁹⁾

Nor is it simply a matter of the shocks that households face. There is also the matter of anticipating and managing risk. This seldom presents simple choices, especially for the poor. Actions taken by households to limit their exposure to risk can result in substantial loss of income. Households in two flood-prone squatter settlements in Dhaka, for instance, were asked to consider the incentives that would encourage them to relocate to safer locations. Despite the extent and difficulty of their experience of coping with floods, many residents felt that relocation was simply not feasible without considerable incentives – including free land, non-repayable grants and long-term employment opportunities.⁽⁸⁰⁾ For those already in poverty, the costs of effectively managing risk may be excessive and can have long-term implications.

Gradually worsening conditions can undermine the precarious stability of households, and when the family system faces more pressure than it can easily adapt to, this can have critical consequences for children on all fronts. The stability of the household may be viewed as more important than the welfare of an individual child, as seen, for instance, in the allocation of food and other resources.⁽⁸¹⁾ Many households make great sacrifices on behalf of their children; but in others, few of the benefits of what is earned or produced actually trickle down to reach children. Children can qualify as being in absolute poverty even in a household that does not.⁽⁸²⁾ When times are hard, children can become an asset that is drawn on to maintain the equilibrium of the household. They may be taken out of school to work or take care of younger siblings, and some children may be considered more “expendable” than others.⁽⁸³⁾ Many of Bombay's young prostitutes, for example, are from poor rural villages in Nepal, where inadequate crop yields lead families to sacrifice one child so others may survive.⁽⁸⁴⁾ Multi-dimensional definitions of poverty

Betsy Lozoff, Gail A Wasserman, Ernesto Pollitt, Julie A Carter and the International Child Development Steering Group (2007), “Child development: risk factors for adverse outcomes in developing countries”, *The Lancet* Vol 369, pages 145–157.

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encourage broad thinking about the assets and risks that actually affect a family's capacity to cope and move ahead in the world. However, these definitions would be still more comprehensive if they took into account the extent to which families are drawing on their children as assets, or investing in them to ensure their optimal development.

The child-centred priorities of mothers are widely recognized,⁽⁸⁵⁾ but in difficult circumstances, these very priorities can result in levels of fatigue and stress that take a serious toll. Women in a Ghana town, for instance, spoke of the degree of their chronic anxiety, tiredness and physical aches and pains: "What will the children eat? What will they wear? One of them is sick, she has to go to the hospital, where do I get the money? So every time you are thinking. When it's night and I lie down I won't sleep."⁽⁸⁶⁾ Mental health problems, which are increasingly acknowledged to be a significant health problem among the poor and especially among women, are closely tied to unpredictability, uncertainty and general insecurity.⁽⁸⁷⁾ These factors are likely to be exacerbated by climate change. There is growing evidence, for instance, of significant associations for women between food insecurity and anxiety and depression.⁽⁸⁸⁾ The combination of economic problems and psychological stress in a mother can result in significant risks for her children. Community-level supports are important here. Mothers who are involved in mutually supportive relationships through community institutions have been found to be less likely to have malnourished children, for instance, than those who are isolated within a family.⁽⁸⁹⁾

Despite this litany of challenges, it is, again, misleading to think of children simply as victims. There are numerous accounts of their hardiness and resourcefulness in the face of both extreme events and everyday difficulties.⁽⁹⁰⁾ Children's capacity to cope well in difficult situations has frequently been related to their own active engagement and to opportunities to be involved in active problem solving.⁽⁹¹⁾ Repeated experience demonstrates how capable children are of looking critically at local problems and coming up with creative solutions that may not have occurred to adults.⁽⁹²⁾

III. THE IMPLICATIONS FOR ADAPTATION

In seeking to reduce vulnerability and enhance resilience in the face of various hazards and risks, how can the multiplicity of concerns for children of different ages be adequately represented without completely overwhelming any agenda?

In every aspect of adaptation – protection, preparation, relief and rebuilding – and at every level of response – including community, local government, NGO, national government, international agency – some basic principles can be taken into account:

- Children's requirements must be adequately understood. Unless various actors understand the implications for young people, the steps they take to respond to the crises of climate change are likely to be mis-targeted in some important ways.
- Children's priorities may differ from assumptions made by adults on their behalf. The information on which decisions are based must be information that can be trusted to represent children's experience.

- Incorporating a focus on children may mean changing the threshold at which an event or situation is considered potentially “disastrous”, or at which adaptation is considered necessary. It will also mean broadening the scope of adaptation to include issues that are not always considered to be central – but that in fact have benefits beyond those for children.
- As with gender, a consideration of age needs to be a routine feature of decision making on every front, not a separate set of activities. The “add-on” approach results in superficial band-aid solutions.

Within each aspect of planning for adaptation, whether in preparation or response, a concern for children means responding in four different areas, which can be considered in the appropriate detail at each level of action. Taking these guidelines into account, in other words, would mean something different to a donor agency and to local government agencies.

- **Ensuring children’s optimal health and nutrition:** Attention to children’s health is important not only for the obvious and immediate benefits but also because of the effects on enhancing children’s resilience generally and supporting their long-term development on every front. For example, a period of nutritional deprivation that is short-lived by adult standards may have far more critical implications for children. When disaster strikes, both the urgency of the response and its effectiveness will be affected by children’s pre-existing levels of health. For donors, this may mean accepting that food aid programmes in response to a crisis are relatively ineffective compared to longer-term programmes. When children’s health is already compromised by illness and malnutrition, they are more likely to sustain long-term damage to their development in the wake of a crisis, even with emergency food programmes.⁽⁹³⁾ For local government, a concern with children’s health may become an additional reason for tackling environmental sanitation problems in underserved areas, as part of preparation for extreme events. For a community disaster preparedness committee, it might mean ensuring that information regarding risks to children’s health of playing in flood waters is disseminated before the rainy season.
- **Strengthening families’ capacity to cope:** All adaptive measures geared at the urban poor should ideally enhance their capacity to come through periods of shock without succumbing to major household catastrophe. But “coping” in this context may take on broader meaning where children are concerned and will include the capacity of households to manage hardship without compromising the well-being of their children. NGOs, for example, might build child impact assessments into their microcredit activities, ensuring that loan repayments do not compromise children’s nutrition; a health care system might allocate more of its resources to mental health supports; emergency response planning could include planning for the provision of temporary child care, so that parents can have some hours each day to focus on recovery without worrying about their young children. Any supports focusing directly on children’s health, safety and care will ease the burden on older family members.

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- **Maintaining, restoring and enhancing the potential for children's daily routines and activities:** Children need supportive functional adults in their lives, but they also rely on their daily routines and activities and on contact with their peers as a context for stability and optimal development. Other functions, more critical to survival, will inevitably be prioritized in preparing for, or responding to, crises on whatever scale – such as the protection of life and property, or attention to food, health and livelihoods. But in the course of addressing these things, it is important that children's spaces, activities and networks not be compromised – they should be identified, maintained and restored wherever possible. In paving and upgrading local streets to prevent them washing away during increasingly common floods, for instance, speed bumps or sidewalks could be included to ensure that children are not endangered by faster traffic; in selecting space for emergency shelters, schools can be avoided where other possibilities also exist; in an emergency camp, a quiet space can be made available where children can do homework away from the noise and chaos of the camp.
- **Respecting children's capacities; allowing them the chance for active involvement:** Despite the litany of challenges that children may face in the context of climate change, it is, again, misleading to think of them simply as victims. There are numerous accounts of their hardiness and resourcefulness in the face of both extreme events and everyday difficulties.⁽⁹⁴⁾ The chance to solve problems and take action has been identified as a potent protective force for children in situations of adversity, allowing them some sense of control in situations where they might otherwise feel helpless and preoccupied by anxiety. Opportunities to demonstrate their competence and contribute to a common effort can build confidence and a sense of effectiveness and camaraderie that can go a long way towards relieving distress. These opportunities do not need to be artificial attempts to include children; there are many real-life occasions for problem solving and improvements in surroundings in both the post-disaster context and in the more "everyday" context of urban poverty.⁽⁹⁵⁾ It should never be assumed that these are inappropriate for children. The contribution of young people is a potential community asset that is too seldom tapped in the process of development and adaptation. In the course of local risk assessment and monitoring, for instance, children's extensive knowledge of their own neighbourhoods could be recognized and drawn on; NGOs rebuilding after disasters could involve children along with adults in critiquing and modifying plans for relocated housing and community space, since they will inevitably point to concerns that adults will overlook.

Adding these concerns to the already long list of urgent priorities for adaptation may appear to be unrealistic. Fortunately, there is considerable overlap between the measures needed to protect and support children and those that are essential for reducing and responding to risk more generally. The most useful measures to protect children's health, for instance, also happen to be fundamental in reducing risks from potential disasters. Adequate provision for waste removal and drainage inhibits the potential for faecal contamination in the event of heavy downpours, and reduces

the likelihood of diseases that predominantly affect children – but it also protects communities from the chronic flooding that can result from insufficient drainage or garbage-blocked drains. Making safe appropriate land available for housing for low-income groups may diminish the risks associated with flooding or landslides that most seriously threaten children, but will also encourage greater investment in homes and neighbourhoods, further minimizing the likelihood of future damage.⁽⁹⁶⁾

Risk reduction measures can even have unexpected benefits for children. In Bangladesh, for example, flood control embankment projects to protect people in low-lying areas and stabilize river banks turned out to have highly significant effects on child mortality rates, which were 29 per cent higher outside these areas. Improvements in agriculture and fishery production, easier access by land to health centres, and a lower risk of drowning were all reasons in themselves to undertake flood control, and involved no additional investment.⁽⁹⁷⁾

Table 2 provides a very brief summary⁽⁹⁸⁾ of some adaptations and responses that take children into account.

IV. CONCLUSION

There are many vulnerable populations in the context of climate change – the poor, the elderly, pregnant women, those in particular locations. Children are not unique in this sense. However, they constitute an extremely large percentage of those who are most vulnerable, and the implications, especially for the youngest children, can be long term. If speculation about the impacts of climate change fails to take into account the particular vulnerabilities (as well as capacities) of children at different ages, measures for disaster prevention and for adaptation may prove to be inadequate in critical ways, and may even result in additional stresses for young minds and bodies.

Addressing these concerns for children may appear to be an unrealistic burden, adding unduly to the need for time and resources in the face of so many other compelling priorities. Fortunately, this is not a zero sum game. As stressed in this paper, there are strong synergies between what children need and the adaptations required to reduce or respond to more general risks. The most useful measures to protect children's health are also fundamental in reducing risks from potential disasters – such as adequate drainage, waste removal and proper sanitation. Supporting adults so that they are better able to address their children's needs also leaves them better equipped to work collaboratively on reducing risks, preparing for disasters and rebuilding their lives after a crisis. Ensuring that children continue to have opportunities to play, learn and take an active role in finding solutions will prepare them to be the citizens we need in order to continue addressing the problems faced by their communities and by the planet. It has generally been found that neighbourhoods and cities that work better for children tend to work better for everyone, and this principle undoubtedly applies also to the adaptations that are being called for by climate change.

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TABLE 2
Adaptations and responses that take children into account

	Reducing longer-term risks	Preparing for extreme weather events	Responding to immediate losses and threats following extreme weather events	Adapting to impacts and losses, and rebuilding to reduce future risks
Children's health, safety and nutrition	<ul style="list-style-type: none"> * Nutritional programmes to ensure children can withstand a crisis * Piped water, toilets and drains (with synergies for disaster reduction) * Measures such as mosquito nets 	<ul style="list-style-type: none"> * Teach children basic survival skills (such as swimming in flood-prone areas) * Families develop strategies for avoiding separation, such as rendez-vous points * Ensure adequate supplies of food and drinking water 	<ul style="list-style-type: none"> * Reduce the risk of sanitation-related diseases in emergency camps * Attend to safety hazards in post-disaster environments * Reproductive health services for young girls as well as women * Support for breastfeeding mothers 	<ul style="list-style-type: none"> * Ensure that rebuilding/ upgrading is a chance to address environmental health issues * Rebuild in ways that make children's play and mobility possible without risk * Ensure adequate storage space in houses to keep hazardous items away from small children
Family and community coping strategies	<ul style="list-style-type: none"> * Child impact assessments to accompany poverty reduction measures * Financial incentives for managing risk, with a focus on children's vulnerabilities * Collaboration between child-focused agencies and those supporting community development 	<ul style="list-style-type: none"> * Encouraging collaborative community measures rather than individualistic responses * Dissemination of local disaster preparedness information, with a focus on children's well-being 	<ul style="list-style-type: none"> * Organize shelter so that family members and communities are kept together * Support children's resilience by supporting stable, functioning adults * Involve communities in post-emergency planning and decision making; allow them to decide on their own needs and priorities 	<ul style="list-style-type: none"> * Location – access to jobs, markets, facilities etc. * Local space flexible enough for small enterprises * Register house sites in women's names; women's involvement in decision making * Housing design responsive to need for privacy * Vegetation, common space to encourage social interaction
Children's daily activities and routines	<ul style="list-style-type: none"> * Placing speed bumps on upgraded roads * Planting shade trees where heat stress is an issue * Ensuring that accommodating to risks does not become a substitute for preventive adaptations 	<ul style="list-style-type: none"> * Avoid selecting schools as emergency shelters 	<ul style="list-style-type: none"> * Get schools and child centres up and running again as soon as possible * Quiet space where children can do homework * Safe play space for young children * Keep children safe from harassment and abuse, e.g. lighting the way to the toilet * Restore a sense of normalcy by recreating, as far as possible, daily chores and routines 	<ul style="list-style-type: none"> * Pockets of space where small children can play close to home * Community space that supports varied activities for older children * Space where girls can socialize without feeling exposed to criticism or harassment * Sidewalks, layouts, street lights that encourage safe mobility
Involving children in decision making	<ul style="list-style-type: none"> * Involving children in environmental monitoring and assessment * Child-to-child health approaches, e.g. assessing patterns of diarrhoeal disease * Supporting children's active stewardship through training and education 	<ul style="list-style-type: none"> * Make disaster-related information available and understandable to children * Involve children in monitoring hazards, in disaster preparations and risk reduction measures 	<ul style="list-style-type: none"> * Relief information accessible and understandable to a 12-year old child * Young people to have input on issues that concern them in emergency camps * "Participation" that means genuine engagement, not tokenistic activities 	<ul style="list-style-type: none"> * Giving children a genuine say concerning their own priorities * Embedding children's responses into more general planning

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