

Children— a large and vulnerable population in the context of climate change

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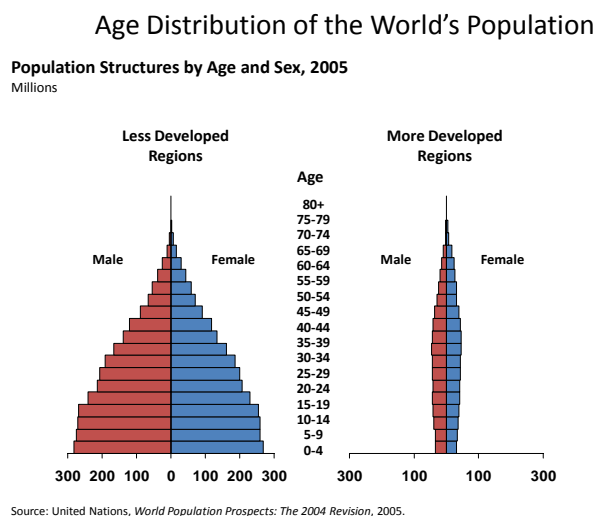
I. Introduction

It is generally accepted that low income countries and poor communities are most seriously at risk from the probable impacts of climate change. This is not because climate change will necessarily be more extreme in these places (although this is often the case¹), but because people, their enterprises and places they occupy are so much more vulnerable in the context of poverty. They are less well served by protective infrastructure and services, less able to adapt and prepare for extreme weather events, often more dependent on local climate-sensitive resources. In urban areas especially, they frequently occupy the most risk-prone areas. Among these vulnerable poor populations, children, and especially very young children, are especially at risk for a number of reasons which this paper will discuss. The fact that children in poor countries and communities also tend to make up a very large part of the population only serves to heighten the concern. In order to be most effective, measures taken to adapt to climate change must take into account the disproportionate and often different ways in which children can be affected, bearing in mind not only their substantial presence and their vulnerability, but also their potential resilience, with adequate support, and their capacity to contribute actively to adaptation measures.

II. Background

Despite the rapid global decline in fertility over recent decades, which has occurred even in most low income countries, a very high proportion of the population in these countries still consists of children and adolescents.² (Figure 1)

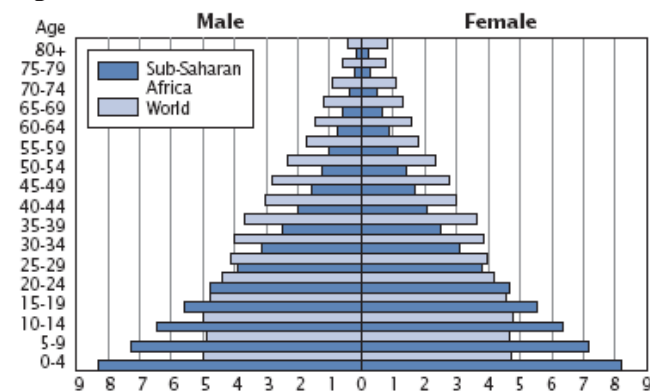
Figure 1



In high-income countries, people under 18 make up about 20 per cent of the population. In many of the countries most exposed and most vulnerable to climate change, they form closer to half the population (for instance, 42 per cent in Bangladesh, 51 per cent in Nigeria, 57 per cent in Uganda.) Even more to the point is the proportion of very highly vulnerable children under five – they make up between 10 and 20 per cent of the population in countries more likely to be seriously affected (for instance, 11 per cent in India, 12 per cent in Bangladesh, 17 per cent in Nigeria and Mozambique, 21 per cent in Uganda). In higher-income countries, the proportion of under fives is closer to four or five per cent.¹

This lopsided distribution is most apparent in sub-Saharan Africa, where over 40 percent of the population is under 15 (Figure 2). Here, as well as in North Africa and the Middle East, also in many parts of Asia, the largest sector of the population is that under five years of age. This is despite under-five mortality rates that continue to exceed 100 per thousand live births in some countries.

Figure 2



Source: US Census Bureau, International Programs Center, International Database 2002.

Within countries, differences in distribution also exist, and again, it is often the poorest communities that have the highest proportions of children. For instance, the Indian census for 2001 showed that 7 percent of Mumbai’s population was under five years of age. However, a 2002 household survey of almost 80,000 pavement dwellers in Mumbai showed 14 percent of under fives, double the proportion in the city at large.³

The child population is expected to grow more slowly over coming decades than the population as a whole, and in many parts of the world is expected to decline in number. But in those places where the proportions of children are already highest, the absolute number of children is expected to continue growing. Increasing numbers of these children will live in urban areas over coming decades, often in the informal settlements and hazard-prone parts of cities which are frequently the only places where land can be found. Especially in the context of rapid urbanization, these settlements can be among the most vulnerable to extreme weather events.⁴ It is difficult to generalize on how urban age structures are changed by migration, since this depends on the nature of the migration, for instance, whether it is temporary, seasonal, long-term. But high levels of in-migration often increase the proportion of young adults and can lead to increased birth rates. A city’s age structure may also be influenced by substantial out-migration by older groups as they return to ‘home’ villages or towns.)

¹ United Nations Children’s Fund (2007) *The State of the World’s Children*, UNICEF, New York.

What does all this mean in the context of climate change? In the broadest and most simplified terms, it means that the populations most vulnerable to the likely challenges posed by climate change are also those with the highest concentrations of children in need of care, and with the lowest ratio of caregivers and bread winners to children. This reality arguably increases the vulnerability of these populations in a rather dramatic way. Larger numbers of young children add to the burdens simply by virtue of their age and need for care. But also, in the context of many of the hazards posed by climate change, their needs are likely to intensify, since their stage of development leaves them especially vulnerable to many of these hazards. Children who become ill, malnourished, injured or psychologically affected by disasters, famines, displacement or deepening poverty will add to the challenges faced by their families and communities. With appropriate support, children can be extraordinarily resilient to shocks and stresses, but in extreme situations that affect many people, these supports may not be reliably present.

This is not the only reality posed by high concentrations of children however. Young children unquestionably need care. Older children and adolescents need care too, but they also can, and do, contribute to their households and communities in a range of ways. It is easy to overlook their energy, ingenuity and eagerness to be involved in meaningful ways. Ten to 18 year olds are a substantial part of the population, especially in low income countries and communities. But in terms of formal planning for adaptation and preparedness, they are a resource that is too seldom recognized and drawn on.

This paper will not attempt to provide a more detailed analysis of the relevant population trends. But given these very basic realities, policy and planning for adaptation in the face of climate change needs to be based, among other things, on an understanding of the particular vulnerabilities of children not only to climate change but to a range of measures taken to adapt to climate change. It is also important to understand how resilient children can be, and how productive and proactive in responding to challenges in their lives. Adaptation, in these terms, means considering how to strengthen and support the capacity of children and adolescents 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.

III. Understanding the impacts for children of climate change

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.⁵ Their more rapid metabolisms, immature organs and nervous systems, developing cognition, limited experience and behavioural characteristics all contribute to their vulnerability. here. Their exposure to various risks is also more likely than with adults to have long-term repercussions.

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 developmental outcomes is considered to increase cumulatively with the number of risks that they face, whether physiological or psychological.⁶ 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. At the same time, it is important to recognize that relating risks to outcomes for children is not a simple matter of accounting. Many variables come into play, including the meanings that events have for people, and these variables can relate to one another in complex ways.

There has been little hard research on the impacts of climate change for children. Even where more general impacts are projected, figures are seldom disaggregated by age. But the fact is that for the large part, the challenges associated with climate change will intensify existing difficulties, not present an entirely new set of conditions. We can legitimately extrapolate from existing knowledge on environmental health, disaster responses, household coping strategies, the effects of poverty for children, children's resilience, and the beneficial effects of their participation in various efforts. These all contribute to a picture of the implications for children and adolescents of extreme events as well as more gradual changes, and of the adaptations likely to be made.

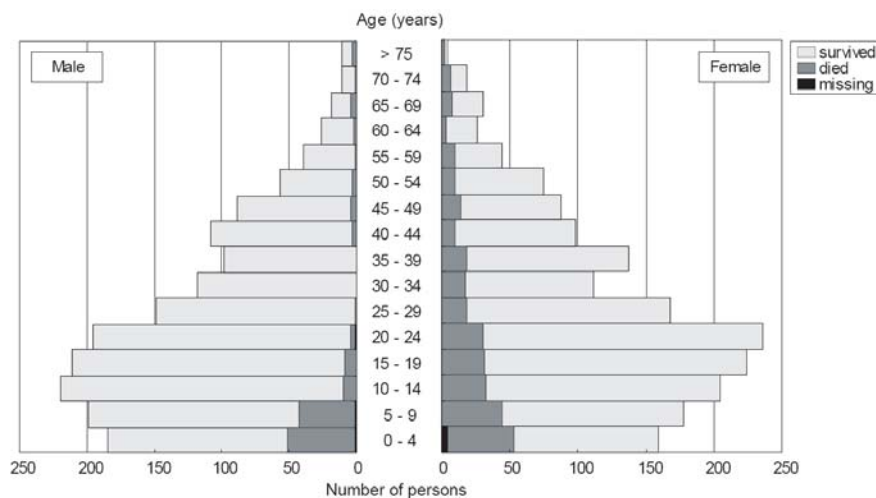
Health and survival

The disproportionate health burden for children of challenging environmental conditions is well documented. According to a conservative estimate, children under 14 are 44 percent 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.⁷ 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 in extreme events: In low-income countries, the loss of life is shown repeatedly to be disproportionately high among children, women and the elderly, especially among the poor, during such extreme events as flooding, high winds and landslides. A study of flood-related mortalities in Nepal, for instance, found that the death rate for children aged two to nine was more than double that of adults; and pre-school girls were five times more likely to die than adult men. The risk for poor households was six times that of higher-income households.⁸

The distribution of deaths related to the 2004 Indian Ocean tsunami followed a similar pattern, as shown in figure 1.⁹ Although the tsunami was not related to climate change, it can still provide insight into patterns of death during an extreme event. The higher mortality rates here for girls and women has been related to the fact that they are more often responsible for small children, a fact which may limit their mobility. The loss of these primary caregivers can leave surviving children and families still more vulnerable.¹⁰

Figure 3: Age and gender distribution of tsunami-related deaths



Source: Nishikiori, N, T Abe, DGM Costa, SD 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* 6: 7.

In slower onset disasters like droughts and famines, mortality rates are also more extreme for young children. Situations are commonly defined as emergencies when crude mortality is 1/10,000/day and under-five mortality is double that.¹¹ Although the higher rate for young children is not unreasonable, given average under-five mortality rates in low income countries¹² it still highlights a grim reality – that high mortality rates for young children, which would be unthinkable in high-income countries, should be 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: Children under five are the main victims (80 per cent globally) of sanitation-related illnesses (diarrhoeal disease primarily) because of their less developed immunity and because their play behaviour can bring them into contact with pathogens. This also results in higher levels of malnutrition and increased vulnerability to other illnesses, with effects on overall development. During heavy or prolonged rains, blocked drains and flooded latrines can make contamination difficult to avoid, increasing the incidence of diarrhoeal illness in children.¹³ 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. After extreme events, diarrhoeal illnesses related to breakdowns in sanitation can take more lives than the initial disaster.¹⁴

Malnutrition: Malnutrition results from food shortages (as a result of reduced rainfall, other changes affecting agriculture, interruptions in supplies during sudden acute events). But it is also closely tied to unsanitary conditions and to children's general state of health. Even when there is enough food to go around, the calorie intake of small children in dirty surroundings may go in large part towards fighting off infection.¹⁵ When children are malnourished, their vulnerability to infection is also greatly increased, and a vicious cycle results.¹⁶ A chronically malnourished two or three year-old may be at a permanent disadvantage, becoming both physically and mentally stunted,¹⁷ Children in Africa born in drought years, for example, are significantly more likely to be malnourished or stunted (in Kenya, 50 percent more likely to be malnourished; in Niger, 72 percent more likely to be stunted.)¹⁸ Research in Zimbabwe found that children who had been in the critical 12 to 24-month age group during a drought in the early 1980s were, in adolescence, an average of 2.3 inches shorter than the mean. Their potential loss in lifetime earnings was calculated to be 14 per cent.¹⁹

It is important not to underestimate the long term implications of the malnourishment that may accompany climate change – not only for the children involved, but also for their families and for society at large. If children are basically healthy and well fed, catch up growth will happen quickly once recovery is under way. But if children are already undernourished, they are less likely to withstand the stress of an extreme event either in terms of their immediate response or their long term development. Infants are at particular risk. Stresses related to a crisis may affect mothers' breast milk production; at the same time, breastmilk substitutes present a serious health risk in unsanitary environments.²⁰ Malnutrition appears to be a greater risk among children of displaced families.²¹ 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.

Malaria and other tropical diseases: Warmer average temperatures are expanding the areas where many tropical diseases can occur, with children most often the victims.²² In many locations, the most serious threat is malaria. Up to half of the world's population is now considered to be at risk, an increase of 10 percent in the last decade.²³ More than 90 percent of the burden is in Africa, where 65

per cent of mortality is among children under five.²⁴ Malaria also increases the severity of other diseases, more than doubling overall mortality for young children.²⁵ There is growing evidence, too, of its impact for development more generally. These potential effects can result directly from the insult to the brain during acute episodes of malaria, but can also be related to the effects of anemia, repeated illness and undernutrition associated with the disease.²

Heat stress: Young children, along with the elderly, are at highest risk from heat stress. For children, this is because they sweat less and have more surface area relative to body mass.²⁶ Research in São Paulo found that for every degree increase above 20°C, there was a 2.6 per cent increase in overall mortality in children under 15 (the same increase as for those over 65).²⁷ Risks for younger children are even higher. Those in poor urban areas may be at highest risk because of the “urban heat-island” effect, high levels of congestion and little open space and vegetation.²⁸ Higher temperatures can also increase the risk of disease. In Peru, for instance, over a 6 year study, hospital admissions for diarrhea for young children increased by 8 percent with every degree centigrade increase above the normal average temperature.²⁹

Injury: Injury rates are related to challenging conditions, overcrowding, complexity in the environment and higher levels of preoccupation on the part of adults³⁰ – all factors commonly experienced in the post-disaster context, as well as in the context of gradually worsening conditions. Children, because of their size and developmental immaturity, are particularly susceptible and are more likely to experience serious and long-term effects (from burns, broken bones, head injuries, for example) because of their size and physiological immaturity.³¹

Quality of care: Despite their considerably greater vulnerability to a range of health hazards, young children can thrive even in difficult conditions with adequate care and support. However, as conditions become more challenging to health, so do the burdens faced by caregivers, especially in groups where there are large concentrations of small children. These problems are seldom faced one at a time – risk factors generally exist in clusters. 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.

Children’s learning and competence

For some children in some places, the added challenges brought by 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.³² Good health is central to cognitive development. Sick or malnourished children lack the energy to be active learners.³³ Abundant research relates lower cognitive capacity and performance to undernutrition, intestinal parasites, diarrhoeal diseases, and malaria, as well as maternal health and nutrition during pregnancy and maternal stress both during and after pregnancy.

Learning also depends on supportive social and physical environments and the opportunities to master and build on new skills. Mental growth and development does not just happen to children; it’s a feedback process that requires their active involvement.³⁴ They need access to social interaction and to safe, varied, stimulating surroundings for play, which support their development as capable problem solvers and responsive social beings.³⁵ When supportive environments and routines break down, so do opportunities for engagement and learning.

² Holding, PA and Snow, RW (2004) “Impact of Plasmodium Falciparum malaria on performance and learning: review of the evidence”, *American Journal of Tropical Medicine and Hygiene*, 71(2 suppl) 68-75

For older children and adolescents as well, opportunities for purposeful goal directed activities and engagement in the world are primary avenues for the achievement of competence.³⁶ When people are displaced, or when routines are disrupted, both formal and informal opportunities for learning can become constrained. After extreme weather events, for instance, schools may be destroyed, damaged, shut down or taken over as emergency shelters for weeks or even months.³⁷ Conditions for displaced children may also make it difficult to do homework, increasing the likelihood of dropout.³⁸ Children may also be pulled out of school when households experience shocks; either the funds are not available, or children's time is needed to help out the family.

At the same time, it should be recognized that numerous opportunities for learning and engagement exist within the context of adversity if children are given the space and support to be productively involved.

Coping with adversity

Much of the research and programming responding to the impact of extreme events for children has focused on their vulnerability to trauma. This approach has also been criticized by many as a western construct with questionable validity for other cultural realities.³⁹ As Engle and colleagues point out, the expectation of negative outcomes in these situations can unwittingly become part of the problem.⁴⁰ Much of what is defined as symptomatic of pathology (such as bedwetting, regression to younger behavior, anger or depression) may also be construed as a normal reaction to abnormal conditions. Frequently, it is the *aftermath* of a traumatic event and the deprivations and humiliations of a slow recovery process (rather than the initial event) that children and families themselves report as being the most stressful and debilitating.⁴¹

Levels of psychological vulnerability and resilience depend on numerous factors, including children's health and internal strengths, household dynamics and levels of social support, as well as the way experiences are perceived and interpreted.⁴² Children who have experienced success and approval in their lives are more likely to adapt well to adversity than those who have suffered rejection and failure. Poverty and social status can play an important role in this regard. But without question, the losses, hardships and uncertainties surrounding stressful events can have high costs for children.

Especially in low income countries, children may end up orphaned or separated from family as a result of disaster. Extended family or other community members can provide a secure alternative, but even these bonds can be frayed to the breaking point, and extra children can become a target for mistreatment.⁴³ 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, community life and social supports may have collapsed.

Increased levels of irritability, withdrawal and family conflict are not unusual after extreme events (or even with gradually worsening conditions). Displacement and life in emergency or transitional housing have also 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, lack of privacy and the collapse of regular routines can contribute to anger, frustration, violence and .⁴⁴ In emergency camps, after the tsunami, adolescent girls especially report sexual harassment and abuse.⁴⁵ High levels of stress for adults can have serious implications for children of all ages, contributing to neglect or to more punitive responses. Increased rates of child abuse have long been associated with such factors as parental depression, increased poverty, loss of property or a breakdown in social support. For instance, in the six months after a hurricane in the US, rates of inflicted head injury to children under two were found to have increased five-fold.⁴⁶

The synergistic and cumulative effects of such physical and social stressors can affect children's development on all fronts. As the numbers of displaced people grow, these dysfunctional environments could become the setting within which more and more children spend their early years. Save the Children cites a UN estimate that by 2010 there will be 50 million such environmentally displaced people worldwide.⁴⁷ This estimate almost certainly does not include the huge numbers of people who are temporarily displaced on a regular basis by "small" weather events. In one small settlement in Tamil Nadu, for instance, residents spend increasing amounts of time each year camped on a road nearby their settlement, waiting for water levels to recede to the point where they can re-enter and repair their mud-filled homes. In Kathmandu, Nepal, small children are routinely sent off to live with rural relatives during the monsoon each year, as water levels rise and sewage backs up into their riverside shanties. Older children and adults stay on, camped under plastic, unable to leave school or the jobs they depend on.⁴⁸

Even these less extreme events, seldom registered as "disasters", can create havoc in families' lives. Repeated adversity can result in a significant loss of assets, reducing the capacity to prepare and adapt for other events, and deepening poverty to a level beyond what many households can reasonably cope with. When this happens, children may feel the brunt of it. Recent research from Bangladesh, for instance, shows that when there are not enough calories available within a household to meet the requirements of all members, children are the most likely to be shortchanged.⁴⁹ When times are hard, children can also become an asset that is drawn on to maintain the stability of the household.⁵⁰ They may be pulled from school to work or take care of siblings. Some children may be considered more "expendable" than others.⁵¹ Many of Mumbai's young prostitutes are from poor rural villages in Nepal, where inadequate crop yields lead families to sacrifice one child so others may survive.⁵²

Again, though, it is misleading to think of children simply as victims, and not to appreciate the level of emotional resilience and competency that they can actually bring to adversity. There are numerous accounts of their hardiness and resourcefulness in the face of both extreme events and everyday difficulty.⁵³ Children may in fact be more flexible than adults in their capacity to adapt to extreme situations. It is easy to forget that many children, even in "normal" times, function competently in adult roles, running households, caring for younger children, handling jobs, negotiating a variety of complex realities. This level of responsibility for children may be less than ideal, but this does not diminish the respect they deserve for their capacity to manage challenging conditions. Children's capacity to cope well in very difficult situations has been related to their own active engagement, opportunities for problem solving and for interaction with peers,⁵⁴ and the presence of at least one consistently supportive adult in their lives.⁵⁵

Implications for adaptation

In seeking to reduce vulnerability and enhance resilience in the face of various hazards and risks associated with climate change, how can the many 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 (community, local government, NGO, international agencies, etc.), some basic concerns need to be taken into account if children are to be effectively responded to. These must be based on an adequate knowledge of children's lives and experience and the challenges faced by their caregivers; and they must be integrated into planning, decision making and action, not treated as add-ons after the fact. It is critical, among other things, to recognize the implications of the actual numbers of children in different age groups in any population. In places with very large numbers of young children relative to caregivers and other adults, there may be an underestimation of the community potential for providing adequate care in the context of unusual adversity. Where responses are expected to involve the active

participation of community members, there may also not be a recognition of the conflicting responsibilities for many adults. On the other hand, older children can play a real role in effective adaptation efforts, and this should be thoughtfully capitalized on.

- *Ensuring children's optimal health and nutrition:* Ensuring children's health through adequate nutrition, preventive care and environmental health measures is a potent form of risk reduction. The overall impact of an event will be defined in part by children's pre-existing level of health – and there are implications for both the urgency and the effectiveness of responses. Food aid and supports for health are vital after crises, but when health is already compromised by malnutrition or illness, children are more likely to suffer long-term damage from extreme events and worsening conditions, and also to be a drain on families' capacity to cope. Where extreme events or food shortages are likely, longer term nutritional and health programmes are critical protection and preparation measures, and more effective than humanitarian aid after the fact for children's long term recovery and well being. A concern for children's health is also a compelling additional reason for local governments to tackle environmental sanitation problems in underserved areas, as part of preparation for extreme events.
- *Strengthening families' capacity to cope:* All adaptive measures should ideally enhance the capacity of households to come through periods of shock with minimal upheaval. But supporting family coping strategies takes on broader meaning when children are an explicit part of the equation. This has to include a focus on the capacity for families to manage hardship without compromising the well-being of their children, and a recognition of the time that may be necessary to respond to what may be intensified needs on the part of children. NGOs, for example, might build a child-impact assessments into their micro-credit activities, ensuring that loan repayments 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.
- *Maintaining, restoring, enriching children's routines, networks and activities:* Children rely on their daily routines and activities as a context for stability and optimal development. Other functions, more critical to survival, will inevitably be prioritized in extreme situations (food, health, livelihoods). But in the course of addressing these, it is important not to compromise children's spaces, activities, networks and opportunities for gaining competence (for instance, by ensuring wherever possible that emergency camps not be set up for months at a time in schools; that safe space for play be a priority even right after extreme events.) Mann has pointed out that restoring a sense of normalcy for children even extends to reinstating the chores they are accustomed to, so that their sense of pride and self respect remains intact.⁵⁶
- *Respecting children's capacities; supporting their active involvement:* On a related front, the chance to solve problems, contribute and take action is known to be a potent protective force for children in adversity. Repeated experience also demonstrates how capable children are of looking critically at local problems and coming up with creative solutions that may not have occurred to adults.⁵⁷ Every day, in communities around the world, children and adolescents do their share to keep their households afloat and functioning. Many observers are critical of children's involvement in activities that may affect the time they can give to school and study. Certainly there is the potential for undermining education, and even for serious exploitation. But the fact is that for many children, balancing the demands of school with help for the family stimulates their self reliance, self respect and overall capacities.⁵⁸ But the contribution of children and young people is also a potential community asset that is too seldom tapped in the formal process of development and adaptation. There are numerous precedents for effective action in this area, in disaster risk reduction, preparedness and rebuilding. In the course of local risk assessment and monitoring, for instance, children's extensive knowledge of their own

neighbourhoods can be invaluable; children can also be involved along with adults in critiquing and modifying plans for relocated housing and community space, since they inevitably point to concerns that adults overlook.⁵⁹

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 responses to the impacts of climate change fail to take into account the particular vulnerabilities (as well as capacities) of children at different ages, measures for prevention and 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, there are strong synergies between what children need and the adaptations required to reduce or respond to more general risks. For instance, the most useful measures to protect children's health are also fundamental in reducing risks from potential disasters – like adequate drainage, waste removal, 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 to take an active role in finding solutions will prepare them to be citizens who can 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 as well to the adaptations that are being called for by climate change.

¹ It is worth noting that most of the locations that currently face the most extreme weather events (eg in regard to cyclones/hurricanes/typhoons, heat waves, heavy rainfalls and droughts) are in low- and middle-income nations; also a high proportion of the world's population within the low elevation coastal zone are in low and middle income nations

² Population figures and projections are drawn primarily from PRB (2008) 2008 Population Data Sheet, Population Reference Bureau;

³ These are results from one of the many “enumerations” undertaken by the NGO SPARC in collaboration with its partners Mahila Milan and the National Slum Dwellers Federation (NSDF).

⁴ Parry, ML, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson (eds) (2007) *Climate Change 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, UK

⁵ Engle, P, S Castle and P Menon (1996) Child development: vulnerability and resilience, *Social Science and Medicine*, 43(5) 621-635

⁶ See for instance, Evans, Gary W and English, Kimberly (2002) The environment of poverty: multiple stress exposure, psychophysiological stress, and socioemotional adjustment. *Child Development* 73 (4), 1238-1248; also Werner, E and R Smith (1992) *Overcoming the Odds: High Risk Children from Birth to Adulthood*, Ithaca, NY and London: Cornell University Press for classic research exploring resilience longitudinally in a cohort of children in Hawaii

⁷ Prüss-Üstün, A and C Corvalán (2006) *Preventing Disease through Healthy Environments. Towards an Estimate of the Environmental Burden of Disease*. World Health Organization: Geneva

⁸ 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* 31(1) 57-70.

⁹ Nishikiori, N, T Abe, DGM Costa, SD 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* 6: 7.

¹⁰ Source: Nishikiori, N, T Abe, DGM Costa, SD 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* 6: 7.

¹¹ Sphere Project (2004) *Humanitarian Charter and Minimum Standards in Disaster Response* www.sphereproject.org/

¹² United Nations Children's Fund (2007) *The State of the World's Children*, UNICEF: New York

¹³ See for instance Moraes LR, Cancio JA, Cairncross S, Huttly S (2003) “Impact of drainage and sewerage on diarrhea in poor urban areas in Salvador, Brazil”, *Transactions of the Royal Society of Tropical Medicine and Hygiene* 97(2): 153-8

¹⁴ World Health Organization www.who.int/entity/ceh/indicators/0_14disasterareas.pdf, downloaded October 15 2007

¹⁵ Solomon, N W, M Mazariegos, K H Brown and K Klasing (1993), “The underprivileged developing country child: environmental contamination and growth failure revisited”, *Nutrition Reviews* 51(11) 327–332.

¹⁶ Lechtig, A and B Doyle (1996). “The impact of water and sanitation on malnutrition and under 5 mortality rates”, *WATERfront* (8): 5-19.

¹⁷ Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B. (2006) Developmental potential in the first 5 years for children in developing countries, *The Lancet* 369: 60–70.

¹⁸ UNDP (2007) *Human Development Report 2007/2008*, New York: Palgrave Macmillan

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