

Review paper

Climate change and its impact on nutritional status and health of children

Abstract

Climate change has been one of the most sought out and debated topic of this decade and is evident to have profound effect on human health, climatic conditions and biodiversity. Though changes in climatic conditions has been referred as natural process but scientific investigation has shown that the recent climatic variation has gone beyond the natural level suggesting the evolution of a process i.e. “global climate change”. The disease burden of a population, and how that burden is distributed across different subpopulations (e.g. infants, women), are important pieces of information for defining strategies to improve population health. Disease burden estimates provide an indication of the health gains that could be achieved by targeted action against specific risk factors. The measures also allow us to prioritize actions and direct them to the population groups at highest risk. It has been noticed that one in three developing-country children under the age of five – 178 million children suffers stunting due to chronic under nutrition and poor quality diets. Chronic malnutrition during the first two years of life usually results in irreversible harm. Keeping in view the above conditions this review paper was prepared to pledge the proficiency and save our future population i.e., our children from ill effects of climate change and making people aware how they can save their children with suggestions to overcome the severe and grievous effects of looming climate change.

Keywords: Climate Change, Children, Environment, Food security, Disease

Introduction

Undernutrition remains one of the world’s most serious but least addressed socioeconomic and health problems. The human and socioeconomic costs of under nutrition are enormous, falling hardest on the poorest, especially on women and children (Horton *et al.*, 2009; SUN, 2010). The scores of millions of worllover, as have been the victims of under nutrition early, life face numerous challenges as they grow. They generally encounter an increased risk of illness and death when young, experience difficulties at school, and are mostly unable to make a full scale contribution viz-a-viz the social and economic development of their households, communities and nations during their adulthood (Nabarro, 2010). Suchchildren are more vulnerable to vector-borne diseases.They have been found to be very intimate companions. The physical dangers of extreme weather events–flooding, building collapses, and pose unique threats to young bodies and mind and change worsen each of these risks with children at the receiving end. Added to it is the critical fact that children suffer these effects longer than adults. This critically makes them centre in firming up the climate change responses.

More than 2.5 billion people worldwide depend more or less directly on agriculture for their livelihood, the availability of resources is a matter of survival. Impacts on agricultural production and prices—triggered by either gradual changes in long-term climate trends or more frequent and severe natural disaster—affect poor people through food production impacts, higher food prices, and changes in rural incomes. Understanding and forecasting the agricultural production supply, quality and diversity, as well as where food loss is occurring across regions, will be significant factors in reducing human, environmental, economic and food security impacts. Global climate models suggest that by 2050, climate change will result in additional price increases of 5–25 percent for the most important agricultural crops—rice, wheat, maize, and soybeans—and that higher feed prices will result in higher meal prices. As food prices increase, the risks of malnutrition and poverty increase. Additionally, seasonality, which is compounded by climate change, can have substantial effects on people’s nutritional status. The women and children are particularly vulnerable to malnutrition induced by seasonality. Despite the substantial nutritional impacts of seasonality, policymakers and program implementers are at times unaware of these effects owing to inadequate data(*Nelson et al., 2009*).It is clear from observations across a range of indicators that many fundamental measures of climate are changing. These broad changes, known as “climate change,” threaten the biological systems on which the life, health, and prosperity depend. On the basis of well-established evidence from the past 20 years, there is now a broad consensus among scientific organizations and approximately 97% of climatologists that human-generated greenhouse gas emissions are the main cause of climate change (Molina et al., 2014, Doran & Zimmerman 2009, Anderegg et al., 2010 and Oresker, 2004).Although the effects of climate change are already being felt across the world, the magnitude of the effects of future changes depends on our ability to substantially reduce greenhouse gas emissions and implement adaptation strategies during the ensuing decades to protect children, families and communities from the worst potential effects of climate change.(*IPCC Report,2014*)

Existing Inequities in Child Health

There have been visible improvements in child survival and life expectancies over the half-century, attributable to technological and medical advances. The social factors have also contributed significantly in these achievements. For example, access to education encourages new family structures in which women and children are allocated greater priority in terms of care and allocation of food within the household (Caldwell & McDonald,1982). Educated mothers also begin to move beyond a fatalistic acceptance of high childhood mortality amongst their offspring towards the implementation of simple health-promoting practices, such as keeping a clean home and boiling water before use(Kiros & Hogan 2001).However, there are still substantial inequities in child health outcomes that are inextricably linked to social and economic gradients of advantage and disadvantage within and between countries. Unequal economic growth, unequal conditions of daily living (especially access to food, water, shelter and basic healthcare) and the suppression of human rights (particularly by gender and ethnicity) have led to established inequities in life chances.More than 200 million children under 5 years of age in developing countries do not reach their development potential due to poverty, malnutrition and poor health, which disrupts their cognitive,

87 physical and social-emotional development (Grantham et al 2007).

88 **Climate change may worsen the existing inequities**

89 Climate change will not affect all equally. Because of the risk associated with them, flood
90 and drought zones often overlap with areas of high poverty and low access to essential
91 services such as water and sanitation. This means that children and families who are already
92 disadvantaged by poverty – those with the fewest resources for coping – are likely to face
93 some of the most immediate dangers of climate change.

94 *This can create a vicious cycle:* a child living in poverty or deprived of adequate water and
95 sanitation before a crisis will be more affected by a flood, drought or storm, less likely to
96 recover quickly and at even greater risk in a subsequent crisis. While climate change poses
97 universal threats, tackling it is also an imperative for equity. Unaddressed, climate change
98 will harm the poorest and most vulnerable children first, hardest and longest. Climate change
99 has begun to change our world in unprecedented ways.

100 *Children will suffer disproportionately from climate change and growing environmental*
101 *risks:* Children's vulnerability to vector-borne diseases such as dengue, malaria, and diseases
102 associated with poor water quality, inadequate sanitation and poor hygiene practices, such as
103 diarrheal diseases, is also far higher than adults. In 2015, malaria is estimated to lead to
104 438,000 deaths, of which more than two-thirds are children under 5 years of age. Children are
105 also more susceptible to under nutrition. Diarrheal diseases are a major cause of under-five
106 mortality, and are estimated to result in 530,000 deaths in 2015 alone. Some of the most dense
107 child population areas in the world are likely to suffer substantially from flooding, drought
108 and water and heat stress. These include parts of South Asia, particularly coastal South Asia
109 and south of the Himalayas; the Mekong Delta; the Nile river basin; the Pacific Islands and
110 other Small Island Developing States (SIDS) across the world; Equatorial Africa; and the
111 Pacific coast of Latin America. Due to several major global trends, including demographic
112 and migration trends, more and more people are living in disaster-prone areas and exposed to
113 weather extremes. Those with the highest exposure to climate risks are also likely to
114 experience repetitive crises, which also make it more difficult for poor families and children
115 to recover. Even without climate change, the challenges ahead would stand to be enormous;
116 climate change will significantly compound these challenges.

117 *Children, particularly young children are reliant on adults for their survival and*
118 *development:* whatever happens to adults often has a devastating impact on children too.
119 Besides the direct risks of climate change, children are also affected when climate change hits
120 their parents and other caregivers, such as loss of livelihoods and crop productivity.
121 Moreover, when climate change sparks conflict over dwindling resources, children again pay
122 the price for adults' actions. The impacts of climate change are only just beginning, and will
123 likely continue to worsen over the lifetime of today's children, and future generations.
124 Currently, over half a billion children are living in areas with extremely high levels of flood
125 occurrence, and nearly 160 million live in areas of high or extremely high drought severity.
126 Most of them live in some of the world's poorest countries with the least capacity to manage
127 these environmental risks. Strengthening the resilience of the poorest children and families to

not only absorb these changes, but also adapt and transform, will be critical. It will also require, as part of these efforts, that we address the profound social and economic inequities that drive the ways in which many children will be so deeply impacted by the climate crisis. Climate change and development are inextricably linked. Action on climate change is essential to achieving the Sustainable Development Goals (SDGs), and requires integrated action across social, economic and environmental spheres.(UNICEF,2015)

Climate Change And Child Nutrition

Much less well understood, however, are the links between climate change and nutrition. A clearer picture of how climate change affects nutrition, and how nutrition in turn affects climate change, offers an opportunity to use policies and programs in ways that are mutually beneficial for climate adaptation and nutrition status. Since childhood is the most vulnerable phase in the life of human being, nutritional inadequacies will result in the hampering of the development of the body. If this nutritional inadequacy persists for a longer period of time it results in the growth faltering manifested in the form of low weight, small height, low IQ, etc. Future of the country is determined by the growing generation of the country. It is the health status of children of any country that represents the health status of people of that country. Since this growing generation is going to be the future productive citizens, they should be healthy enough to make use of the full potential of their productive age. Scientific evidence has shown that beyond the age of 2-3 years, the effects of chronic malnutrition are irreversible. Child malnutrition is the single biggest contributor to under-five mortality due to greater susceptibility to infections and slow recovery from illness. Misconception prevalent in the present time is attributed inter alia to the unavailability of the enough food. Between 6-18 months, young child requires only 200-300 kcal food to maintain normal growth and development; but because of insufficient knowledge of parents about feeding practices they don't provide enough food to their children leading to faltering of growth and consequently illness and death of child. (Shiva <http://www.littlemag.com/hunger/shiv2.html>)Studies conducted by some of the researchers show that Children's nutritional status is a reflection of nutritional status of the community (Soharju & Riyadi, 1990), and according to Kardjati(1995) children need special attentions because they are sensitive to the nutrient deficiency and environment influences. Nutritional status can be evaluated in four way: food consumption, anthropometry, biochemistry, and clinical test (Riyadi, 2003). And then the method itself is depending on the stage of nutrients deficiency, time, cost, energy, and degree of research accurateness, and how many people will be evaluated.

The impact of climatechange as a risk for nutrition- the potential of nutrition choices to contribute to climate change mitigation.

It begins by describing the nature of the linkages between climate change and nutrition, and then it looks at various aspects of these links. For example, many poor people in rural areas are vulnerable to seasonal variations in food supply, disease, and time use, and these seasonal changes point to the potential effects of climate change on nutrition.Climate change affects the enabling environment for malnutrition reduction. Shifting and sometimes less predictable rainfall and temperature patterns affect political priorities, economic growth, and inequality because the poorest people are most vulnerable to the changes. A less favorable enabling

environment for malnutrition reduction makes the underlying determinants of improved nutrition less effective. For example, unexpected and sometimes more severe weather changes disrupt the intermediate environments that are so important for good nutrition and climate change also affects people's food consumption by influencing local and global food availability (production, storage), quality (nutritional value and food safety), access (market policies and prices), and how the body utilizes food. Seasonal food scarcity and climate shocks (such as droughts) have long been shown to drive short-term malnutrition, morbidity, and, in Africa, mortality in vulnerable populations, especially women and girls. Global climate models suggest that by 2050 climate change will result in additional price increases of 5–25 percent for the most important agricultural crops—rice, wheat, maize, and soybeans—and that higher feed prices will result in higher meal prices (Nelson et al. 2009). This is because overall warming temperatures are expected to have a negative effect on global crop production, although this effect might be counteracted in part by the effects of CO₂ (Lobell et al. 2012). Without real efforts to adapt, people's production capacity and livelihoods are under serious threat. According to the Intergovernmental Panel on Climate Change (IPCC), climate change without adaptation will depress production of wheat, rice, and maize even under local temperature increases of 2° C.(high confidence). It is also estimated that food quality will be affected. For example, elevated CO₂ emissions representing likely levels in 2050 are associated with substantial declines in the zinc, iron, and protein content of wheat, rice, field peas, and soybeans (Myers et al. 2014). In addition, food safety may be compromised by a changing climate. High temperatures and extreme weather events create a more favorable environment for food-borne pathogens such as campylobacter and salmonella (Tirado et al. 2010), which reduce sufferers' ability to absorb nutrients. It has also been observed by some of the researchers (Robert et al., 2008) that the immediate causes of malnutrition are due to inadequate food intake (in terms of quantity or quality) and diseases. However, malnutrition is influenced by a host of underlying factors related to poverty, including food insecurity, poor water, sanitation and health services, which find their roots in factors that can vary from conflict to climate change; from scarce natural resources to high and volatile food prices; from poor governance to demographic growth. (The Lancet, Maternal and Child Undernutrition Series, 2008.)

As per study conducted by Kelly-Hope and Thomson 2008 it has been revealed that the health environment, climate plays an important role in the transmission of many human parasitic, viral, and bacterial diseases (such as malaria, dengue, and cholera, respectively). With Omumbo et al. 2011 of the notion that rainfall and temperature determine the spatial and seasonal distributions of these diseases, influence year-to-year variability, including epidemics, and affect long-term trends observed warming in the East African highlands, which is clearly associated with global climate processes, may already be changing local malaria transmission dynamics.

Climate Change and Environmental Health Hazards in Childhood

Up to two-thirds of preventable illness and death from environmental hazards is experienced by children [Xu et al 2012, Barlett, 2008 and Bunyavanich et al 2003] and the burden is predominantly in those aged under 5 years (Pronczuk & Surdu 2008). Children have distinct

physiologies and exposure profiles that mean climate-sensitive diseases place an undue burden on the youngest members of society. Compared to adults, children have much higher exposures to environmental hazards.

For example, children tend to spend more time outdoors, where they can be exposed to high temperatures and where disease vectors such as rodents, mosquitos and ticks are found. Children require more water (by weight) than adults, so their exposure to water-borne pathogens is much higher. Diarrheal diseases cause dehydration in children much faster than in adults, and children are more likely to develop severe infection and experience complications during recovery due to their small body size and their developing immune systems which provide little natural immunity or resistance (Barlett, 2008 & Walker et al 2007). Apart from this, there are distinct “windows of vulnerability” during gestation and early childhood, when critical biological systems such as the immune and central nervous system are developing. Maternal undernutrition, infection and illness at these critical times can cause devastating and life-long damage, including physical stunting, neurological impairments and immune dysfunction (Xu et al 2012 & Pronczuk and Surdu 2008).

Pathways between Inequities in Child Health Outcomes and the Impacts of Climate Change on Environmental Hazards

Inequities in child health outcomes may be exacerbated by climate-related changes in the frequency and severity of environmental hazards, especially heat stress, extreme weather events, vector-borne diseases and undernutrition pathways between these particular environmental health hazards, climate change, and issues of inequity that lead to differential health outcomes for children are illustrated in Figure 1.

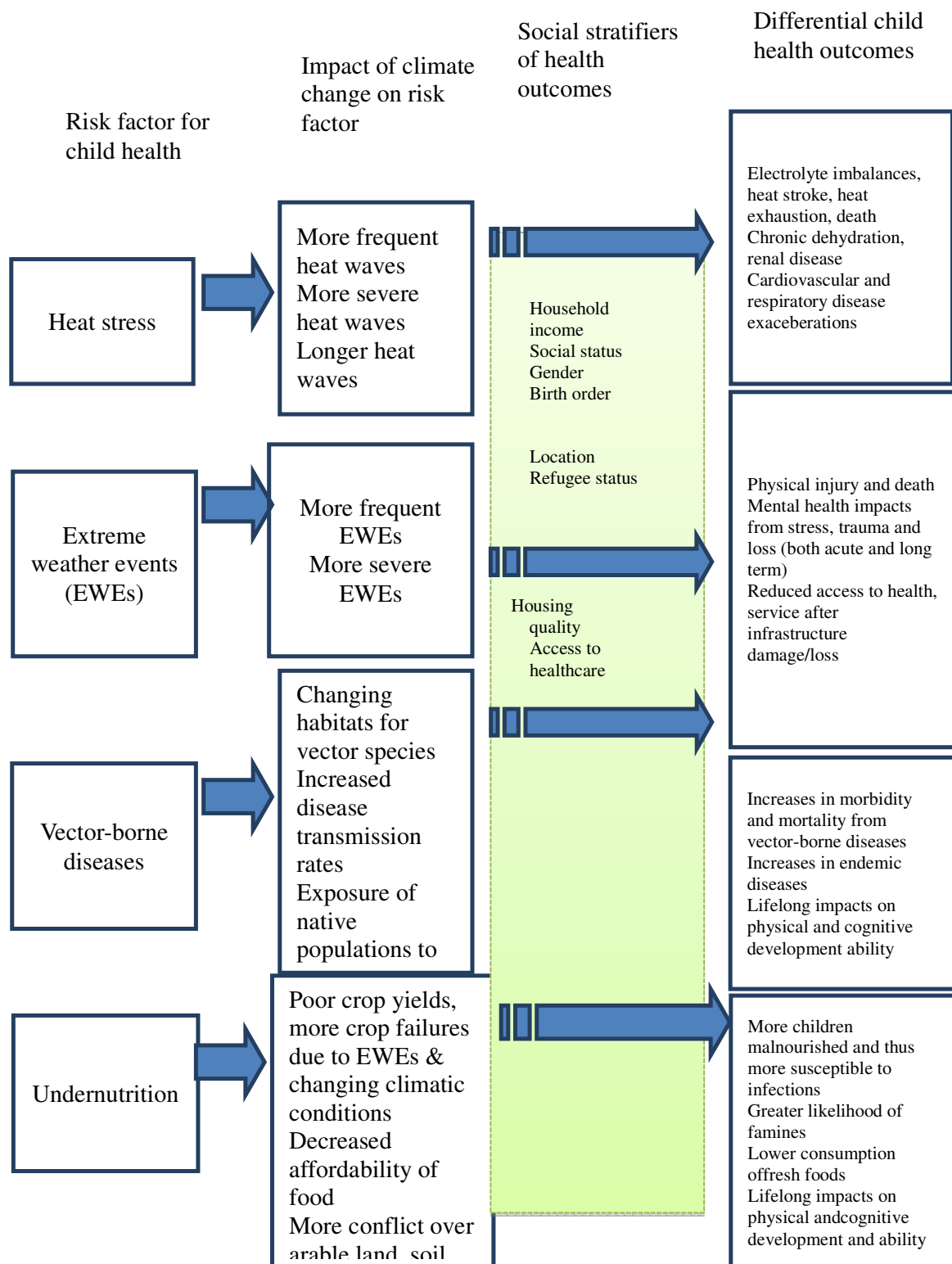


Figure-1 Pathways between selected environmental hazards, climate change, and social conditions that lead to differential health outcomes for children.

Heat Stress

Infants and young children are at high risk of ill-health and death related to extreme heat exposure. Children tend to spend more time outside, with more vigorous activity, than adults, thus placing them at increased risk of dehydration, electrolyte imbalances, heat stroke and heat exhaustion (Xu et al 2012, Shea 2007 and Report Heat related deaths,2002).It has also been observed that the health risks from a heatwave are strongly mediated by social advantage or disadvantage. During a period of extreme heat, a child from a high income family in a developed setting can retreat to insulated buildings, with electricity to run air conditioning and clean, cold water on tap. In contrast, a child living in an urban slum, with no running water or electricity and poorly made shelter, has no refuge from the heat and no way to artificially cool themselves (Kovats & Akhter, 2008). Children in this setting are thus at much higher risk for heat-related illness and death (Smit & Parnell 2012& Sverdlik 2011).

Extreme Weather Events

Climate change is expected to bring more frequent and more severe extreme weather events, such as storms, cyclones, floods and droughts. Children are particularly vulnerable to these hazards as they are heavily dependent on their caregivers for safety and protection during such events. When the immediate threats to health and safety have subsided, there are invariably lingering effects related to material losses (including homes and possessions), infrastructure damage (such as loss of health services or access to relief supplies), the displacement of large numbers of people (which may be permanent), loss of livelihoods and slow economic recovery.

Disadvantaged communities have little ability to cope with disasters, especially a series of events in close succession. They also have little ability to recover and rebuild afterwards (Fussell et al 2010).

Many post-disaster emergency housing settlements are over-crowded, unsanitary and impoverished, and plagued by outbreaks of infectious diseases, episodes of violent conflict over scarce resources and persistent food insecurity. Basic life essentials (such as safe water and adequate shelter) are hard to obtain and livelihoods disappear. Many children become separated from their families and caregivers and are at greater risk of sexual assault, abuse and neglect (Paardekooper, Dejong & Hermanns 1999). In a climate-changed future with more frequent and more severe extreme weather events, and in a context of widening health inequities within and between countries, these unsafe and unhealthy environments will be where growing numbers of children may spend their formative years (Barlett, 2008).

Mental and emotional distress is commonly reported in children and adolescents following natural disasters, including post-traumatic stress disorders, sleep disturbance, aggressive behavior, depression and anxiety, and substance abuse (Shea, 2007,McDermott et al 2005,Dean &Stain, 2007 & Dean & Stain 2010)

Vector-Borne Diseases

Climate change will alter the ecological context in which disease hosts, vectors and parasites breed, develop and transmit disease (Patz et al 2000). The distribution of many infectious disease vectors, including rodents, ticks and mosquitoes, is limited by the availability of suitable habitats and they are highly sensitive to changes in temperature, humidity and rainfall.(Shea 2007, Reites 2001, Subak 2003 & Ogden et al 2006).Poverty often coincides

with regions of endemic infectious disease. Heavy burdens of endemic disease have significant impacts on productivity and health of the workforce, which leads to reduced household incomes and exacerbates economic disadvantage in those who can least afford it (Benett & Micheal, 2010)

The economic costs of a vector-borne disease epidemic are strongly mediated by socio-economic status. Epidemics in populations of low socio-economic status have substantial household costs, including foregone income from sick adults and those caring for sick children, the costs of healthcare and medicines, and missed schooling. Subsistence farmers and their families suffer disproportionately from the loss of income as well as loss of food from their land.

(Boivin, 2002).

Childhood infections can therefore have major impacts on health and well-being in adult life, with survivors burdened with physical and cognitive deficits that lead to a less productive working life, whilst increasing the demands on caregivers, and thus affecting both the strength and the productivity of the future workforce (Benett & Micheal, 2010).

Undernutrition

The impact of climate change on agricultural yields and productivity is likely to have profound impacts on child health outcomes, especially in regions with heavy dependence on subsistence lifestyles and where undernutrition and malnutrition is already prevalent. Children require more food per unit mass than adults (Surdu 2008), and most of the world's hungry are children. Malnutrition already kills more than 3 million children every year (mostly in southeast Asia and sub-Saharan Africa). A further 178 million children suffer from malnutrition, and one third of all children under five in developing countries are chronically malnourished or stunted. (Baker, 2009). Nutrient-deficient diets, undernutrition and malnutrition weaken overall health, and are closely tied to unsanitary living conditions and socio-economic disadvantage [Caulfield et al 2004 & Black et al 2008]. Endemic disease and undernutrition also fuel a vicious self-perpetuating cycle of disadvantage: the risk of infection (and complications from infection) is much higher if the child is malnourished, and the risk of malnourishment is greater if the child already has an infectious disease [Xu et al 2012, Barlett, 2008]. This cycle of poor health leads to permanent physical, cognitive and psychological impairments that will have profound impacts on the ability of that child to lead a healthy and productive adult life, including caring for children of their own. [Black et al 2008 & Victoria et al 2008].

Food insecurity and climate change

The pivotal relationship between food and weather presents significant risk and security exposure for regions all over the globe. From production planning all the way through final consumption, there are numerous critical touch points in the food life cycle where weather and climate can have impacts on crop yields and consumption from minor to catastrophic levels.

In India, food security continues to be high on its list of development priorities because the country's relatively high rates of economic growth have not led to a reduction in hunger and undernutrition. India's gross domestic product at factor cost and per capita income grew at

seven percent and five percent per annum, respectively, from 1990-91 to 2013-14. However, the incidence of undernutrition has dropped only marginally from 210.1 million in 1990 to 194.6 million in 2014, and India has failed to meet the Millennium Development Goal of halving the proportion of people who suffer from hunger. About 12 Indian states fall under the 'alarming' category of the Global Hunger Index. According to the National Family Health Survey 2015-16, the proportion of children under five years who are underweight is significantly high in states such as Bihar (43.9 percent), Madhya Pradesh (42.8 percent) and Andhra Pradesh (31.9 percent). While large sections of the Indian population suffer from acute undernutrition, rising incomes and growing urbanization are rapidly changing the composition of the food basket—away from cereals to high-value agricultural commodities, such as fish and meat. As a result, the total demand for foodgrains is projected to be higher in the future due to an increase in population as well as a growing indirect demand from the feed. Mittal (2008) has made long-term projections of India's food demand and supply up to 2026. According to her, the increase in total food demand is mainly due to growth in population and per capita income while production is likely to be severely constrained by low yield growth. In regions with high food insecurity and inequality, increased frequency of droughts and floods will affect children more, given their vulnerability. Vedeld et al (2014) conducted a survey of nine villages in the drought-prone Jalna district of Maharashtra and found that local crop yields and annual incomes of farmers dropped by about 60 percent in the drought of 2012-13. Such a large fall in income is likely to have a huge impact on child nutrition because poor households typically spend the bulk of their earnings on food. In another study based on 14 flooded and 18 non-flooded villages of Jagatsinghpur district in Orissa, RodriguezLlanes et al (2011) found that exposure to floods is associated with long-term malnutrition. According to their study, children exposed to floods during their first year of life presented higher levels of chronic malnutrition.

Conclusion

While the status report is given and the future full of potential challenges, the mankind appears to be heading for an unprecedented adversity as can threaten the posterity with unprecedented consequences. We seem to have interfered with the nature mainly to satisfy our lust for more and more, and it looks mulling to strike back with vengeance unless we exhibit our will and skill to befriend it and endeavor to take sustentative measures in right earnest.

Even sans the climate change, the food security let alone the quality has remained a distant dream to the brute majority of the world populace. The hunger played a permanent partner to them with occasional intermissions for hide and seek. The mankind knows the weather playing a spoilsport is known to the man kind for ages but the climate change is taking him by surprise and the impact assessment is presently beyond the comprehension many.

The children amongst the disadvantage are more venerable bound to suffer disproportionality from the climate change and growing environmental risks. They are the easy praise and may get harm first, hardest and longest. The vicious cycle that the climate change can foster shall be the challenge that has the potential of threatening the posterity in a big measure. The impact in health, economic and social sectors shall be profound and any further delay in addressing the contributing melodies can prove very costly and even threaten the survival of both flora and fauna.

Given the worsening situation of climate and its catastrophic effects on health of children it is necessary to take some expeditious steps to safeguard our children. There are concrete steps that the world can take now to safeguard our children's future and their rights. Knowing this, and knowing how climate change can affect children, makes it morally wrong not to act promptly and decisively. The environmental hazards and natural calamities apart, children can be affected socially and economically through nutrition related problems like malnutrition, undernutrition and other nutrition related problems indirectly associated with climate change. Climate change science indicates that because of past and ongoing greenhouse gas emissions, the world's climate is already changing. It is imperative that we prepare for the impacts that are inevitable. There is, nevertheless, an opportunity for action that can stave off some of the worst effects of climate change. What the world does now to cut greenhouse gas emissions can dramatically reduce the number of children threatened by the most severe impacts of climate change in the coming decades. The path that the world chooses now will indelibly mark our children's futures.

Climate change acts in conjunction with others factors, and thus is viewed as a threat multiplier. It is changing the patterns of climate-related hazards and it magnifies the risks of disasters. It exacerbates the risk of undernutrition by an unprecedented scale through different pathways, respectively food, water, care & health-related. There is little doubt that climate change – both in terms of impacts and responses –will be further reshaping the humanitarian and development agendas and operations in the coming years; thus climate change should be considered seriously by humanitarian/development decision- and policy-makers and practitioners. Through proper understanding of climate change issue and its impending effects on health, timely initiation of preparedness activities with thorough participation of community, we can become successful in combating the health effects of climate change.

Recommendations

- The world must embark on low carbon development to reduce greenhouse gas emissions, and needs to adapt to the impacts of climate change that cannot be halted. The blueprint with focus on the following charter of objectives could be envisaged:
- Cutting greenhouse gas emissions so that the average rise in the global temperature is limited to a maximum of 2° Celsius, and ideally to 1.5°C.
- Prioritizing the needs of the most vulnerable in climate change adaptation efforts, particularly children – who will bear the brunt of climate, change far longer than adults.
- Reducing inequities among children now to promote their future resilience to climate change and other disasters or crisis.
- Listening to and acting on children's perspectives on climate change.
- Providing children and youth with climate change education, awareness raising and training.
- Aligning and coordinating work on climate change adaptation, preparedness and disaster risk reduction at national and sub-national levels.
- Protecting children and their families who are forced to move as a result of climate

- 421 change.
- 422 ○ Investing in children as part of national climate plans on mitigation and adaptation.
- 423 ○ Scale-up proven approaches to address the changing needs of children.
- 424 ○ A higher priorities given to interventions that help households manage seasonal
- 425 variations in consumption, income, and illness.
- 426 ○ There should be more food aid to drought stricken areas.
- 427 ○ The Government should look for responsive strategies and carry out research on how
- 428 to reduce the impacts of climate change.
- 429 ○ Development and introduction of drought resistant crops.
- 430 ○ Make the needs of the most vulnerable, including children, central to climate change
- 431 adaptation.
- 432 ○ Involvement of one and all in the campaign for the “continued and quality survival of
- 433 all-today and tomorrow”

434 **Reference**

- 435 Horton S., Shekar M., McDonald C., Mahal A. and Brooks J.K. (2009). Scaling Up Nutrition:
- 436 What Will It Cost? Washington DC: The World Bank.
- 437 Nabarro D. (2010). Introducing the policy brief ‘Scaling Up Nutrition: a framework
- 438 foraction’. Available at: [http://un-foodsecurity.org/sites/default/files/April%2024%20](http://un-foodsecurity.org/sites/default/files/April%2024%20David%20Nabarro%20Introducing%20the%20SUN%20April%202010.pdf)
- 439 [David%20Nabarro%20Introducing%20the%20SUN%20April%202010.pdf](http://un-foodsecurity.org/sites/default/files/April%2024%20David%20Nabarro%20Introducing%20the%20SUN%20April%202010.pdf)
- 440 Nelson, G.C., Rosegrant, M.W. et al. (2009) Climate change: Impact on agriculture and costs
- 441 of adaptation. Washington, D.C.: IFPRI.
- 442 UNICEF(United Nations Children’s Fund) 2015 “Unless We Act Now” The Impact of
- 443 Climate Change on Children : Available at www.unicef.org/environment
- 444 Molina M., McCarthy J., Wall D, et al. (2014).What We Know: The Reality, Risks, and
- 445 Response to Climate Change. Washington, DC: American Association for the Advancement
- 446 of Science;. Available at: [http://whatweknow.aaas.org/wp-content/uploads/2014/07/](http://whatweknow.aaas.org/wp-content/uploads/2014/07/whatweknow_website.pdf)
- 447 [whatweknow_website.pdf](http://whatweknow.aaas.org/wp-content/uploads/2014/07/whatweknow_website.pdf). Accessed January 29, 2015 2.
- 448 Doran PT, Zimmerman MK. Examining the scientific consensus on climate change. Eos
- 449 Trans AGU. 2009;90(3):22–23 3.
- 450 Anderegg WR., Prall JW., Harold J, Schneider SH (2010). Expert credibility in climate
- 451 change. Proc Natl Acad Sci USA.;107(27):12107–12109
- 452 Oreskes N.(2004). Beyond the ivory tower. The scientific consensus on climate change.
- 453 Science;306(5702):1686
- 454 Intergovernmental Panel on Climate Change Report.(2014).Climate Change 2014: Mitigation
- 455 of Climate Change. New York, NY: Cambridge University Press; 2014

- 456 Caldwell, J.; McDonald, P. Influence of maternal education on infant and child mortality:
457 Levels and causes. *Health Policy Educ.***1982**, 2, 251–267.
- 458 Kiros, G.-E., Hogan, D.P. War,(2001) famine and excess child mortality in Africa: The role
459 of parental education. *Int. J. Epidemiol.***30**, 447–455.
- 460 Grantham-McGregor, S.; Cheung, Y.B.; Cueto, S.; Glewwe, P.; Richter, L.; Strupp, B.(2007)
461 Developmental potential in the first 5 years for children in developing countries. *Lancet*, **369**,
462 60–70.
- 463 Shiva Kumar A.K ('Child malnutrition: Myths and solutions'-The Little Magazine, myth Vol
464 II (6) <http://www.littlemag.com/hunger/shiv2.html>
465
- 466 Kardjati S. (1995). Gizi Generasi Muda pada Wanita(Nutrition for Young Female
467 Adolescents).Professorship Speech at AirlanggaUniversity, Surabaya.
- 468 Riyadi H.(2003). Metode Penilaian Status Gizi secara Antropometri (A Student Book:
469 Method of Anthopometric Nutritional Assessment). Department of Community Nutrition and
470 Family Resources, Faculty of Agriculture, Bogor Agricultural University, Bogor.
- 471 Myers, S. S., Zanobetti, A., Kloog, I., Huybers, P., Leakey, A. D.B., Bloom, A. J., . . . Usui,
472 Y. (2014). Increasing CO2 threatens human nutrition. *Nature*, **510**, 139–142.
- 473 Lobell, D. B., Sibley, A., & Ortiz-Monasterio, J. I. (2012). Extreme heat effects on wheat
474 senescence in India. *Nature Climate Change*, **2**(3), 186–189.
- 475 Tirado, M. C., Clarke, R., Jaykus, L. A., McQuatters-Gollop, A., & Frank, J. M. (2010).
476 Climate change and food safety: A review. *Food Research International*, **43**(7), 1745–1765.
- 477 Black, R.E., L.H. Allen, Z.A. Bhutta, M. de Onis, C. Mathers and J. Rivera. 2008. "Maternal
478 and Child Undernutrition: Global and Regional Exposures and Health Consequences."
479 *The Lancet* **371** (9608, January 19): 243-260.
- 480 Kelly-Hope, L., and M. Thomson.(2008). "Climate and Infectious Disease." In *Seasonal*
481 *Forecasts, Climatic Change, and Human Health*, edited by M. C. Thomson, R. Garcia-
482 Herrera, and M. Beniston, 31–70. Dordrecht, Netherlands: Springer Science+Business
483 Media.
- 484 Omumbo, J., B. Lyon, S. Waweru, S. Connor, and M. Thomson.(2011). "Raised
485 Temperatures over the Kericho Tea Estates: Revisiting the Climate in the East African
486 Highlands Malaria Debate." *Malaria Journal* **10**:12. [http://dx.doi.org/10.1186/1475-](http://dx.doi.org/10.1186/1475-2875-10-12)
487 [2875-10-12](http://dx.doi.org/10.1186/1475-2875-10-12).

- 488 Xu, Z.; Sheffield, P.E.; Hu, W.; Su, H.; Yu, W.; Qi, X.; Tong, S(2012). Climate change and
489 children's health—A call for research on what works to protect children. *Int. J.*
490 *Environ. Res. Public Health*, **9**, 3298–3316.
- 491 Bartlett, S.(2008). Climate change and urban children: Impacts and implications for
492 adaptation in low- and middle-income countries. *Environ. Urban*, **20**, 501–519.
- 493 Bunyavanich, S.; Landrigan, C.P.; McMichael, A.J.; Epstein, P.R.(2003). The impact of
494 climate change on child health. *Ambul. Pediatr.*, **3**, 44–52.
- 495 Pronczuk, J.; Surdu, S.(2008) Children's environmental health in the twenty-first century:
496 Challenges and solutions. *Ann. N.Y. Acad. Sci.*, **1140**, 143–154
- 497 Baker, L. (2009).Feeling the Heat: Child Survival in a Changing Climate; International Save
498 the Children Alliance: London, UK,; p. 22
- 499 Voelker, R.(2009). Climate change puts children in jeopardy. *JAMA*, **301**, 2197–2199.
- 500 Walker, S.P.; Wachs, T.D.; Gardner, J.M.; Lozoff, B.; Wasserman, G.A.; Pollitt, E.; Carter,
501 J.A.(2007). Child development: Risk factors for adverse outcomes in developing
502 countries. *Lancet*, **369**, 145–157.
- 503 Shea, K.M.(2007). Global climate change and children's health. *Pediatrics*, **120**, e1359–
504 e1367.
- 505 Report Heat-related deaths—Four states, July–August 2001, and united states, 1979–1999.
506 *MMWR*2002, **51**, 567–570.
- 507 Kovats, S.; Akhtar, R.(2008,). Climate, climate change and human health in asian cities.
508 *Environ. Urban*.**20**, 165–175.
- 509 Smit, W.; Parnell, S.(2012). Urban sustainability and human health: An african perspective.
510 *Curr. Opin. Environ. Sustain*.**4**, 443–450.
- 511 Sverdlik, A.(2011) Ill-health and poverty: A literature review on health in informal
512 settlements. *Environ. Urban*., **23**, 123–155.
- 513 Fussell, E.; Sastry, N.; VanLandingham, (2010).M. Race, socioeconomic status and return
514 migration to new orleans after hurricane katrina. *Popul. Environ*, **31**, 20–42.
- 515 Paardekooper, B.; deJong, J.T.V.M.; Hermanns, J.(1999,) The psychological impact of war
516 and the refugee situation on south sudanese children in refugee camps in northern
517 uganda: An exploratory study. *J. Child Psychol. Psychiatry* **40**, 529–536.
- 518 McDermott, B.M.; Less, E.M.; Judd, M.; Gibbon, P.(2005). Posttraumatic stress disorder and
519 general psychopathology in children and adolescents following a wildfire disaster.
520 *Can. J. Psychiatry***50**, 137–143.
- 521 Dean, J.; Stain, H.J. (2007).The impact of drought on the emotional well-being of children

522 and adolescents in rural and remote new south wales. *J. Rural Health*, **23**, 356–364.

523 Dean, J.G.; Stain, H.J.(2010). Mental health impact for adolescents living with prolonged
524 drought. *Aust. J. Rural Health***18**, 32–37.

525 Patz, J.A.; Graczyk, T.K.; Geller, N.; Vittor, A.Y(2000,). Effects of environmental change on
526 emerging parasitic diseases. *Int. J. Parasitol.***30**, 1395–1405.

527 Reiter, P.(2001). Climate change and mosquito-borne disease. *Environ. Health Perspect*, **109**
528 (Suppl. 1), 141–161.

529 Subak, S.(2003). Effects of climate on variability in lyme disease incidence in the
530 northeastern united states. *Am. J. Epidemiol.*, **157**, 531–538.

531 Ogden, N.H.; Maarouf, A.; Barker, I.K.; Bigras-Poulin, M.; Lindsay, L.R.; Morshed, M.G.;
532 O’Callaghan, C.J.; Ramay, F.; Waltner-Toews, D.; Charron, D.F.(2006). Climate
533 change and the potential for range expansion of the lyme disease vector ixodes
534 scapularis in canada. *Int. J. Parasitol.*, **36**, 63–70.

535 Bennett, C.M.; McMichael, A.J.(2010,). Non-heat related impacts of climate change on
536 working populations. *Glob. Health Action***3**.

537 Boivin, M.J.(2002). Effects of early cerebral malaria on cognitive ability in senegalese
538 children. *Dev. Behav. Pediatr.*, **23**, 353–364.

539 Caulfield, L.E.; Richard, S.A.; Black, R.E.(2004,). Undernutrition as an underlying cause of
540 malaria morbidity and mortality in children less than five years old. *Am. J. Trop. Med.*
541 *Hyg.***71**, 55–63.

542 Black, R.; Allen, L.; Bhutta, Z.; Caulfield, L.; de Onis, M.; Ezzati, M.; Mathers, C.; Rivera,
543 J.(2008). Maternal and child undernutrition: Global and regional exposures and health
544 consequences. *Lancet*, **371**, 243–260.

545 Victora, C.G.; Adair, L.; Fall, C.; Hallal, P.C.; Martorell, R.; Richter, L.; Sachdev,
546 H.S.(2008). Maternal and child undernutrition: Consequences for adult health and
547 human capital. *Lancet*, **371**, 340–357.

548 Caulfield, L.E.; Richard, S.A.; Black, R.E.(2004,). Undernutrition as an underlying cause of
549 malaria morbidity and mortality in children less than five years old. *Am. J. Trop. Med.*
550 *Hyg.***71**, 55–63. Surabhi Mittal,(2008). “Demand-Supply Trends and Projections of
551 Food in India”, Working Paper No. 209, Indian Council of Research on International
552 Economic Research, New Delhi, [http://indiaenvironmentportal.org.in/
553 files/WORKING%20PAPER%20209.pdf](http://indiaenvironmentportal.org.in/files/WORKING%20PAPER%20209.pdf)

554 Vedeld, T et al.,(2014).“Governing extreme climate events in Maharashtra, India”, Final
555 report on WP3.2: Extreme Risks, Vulnerabilities and Community-based Adaptation in

556 India (EVA): A Pilot Study, TERI Press, New
 557 Delhi, http://www.teriin.org/projects/eva/files/Governing_climate_extremes_in_Maha
 558 [rashtra.pdf](http://www.teriin.org/projects/eva/files/Governing_climate_extremes_in_Maha_rashtra.pdf) 32.

559 Rodriguez-Llanes et al.(2011) Child malnutrition and recurrent flooding in rural eastern
 560 India:a community-based survey”,BMJ Open, 1,
 561 <http://bmjopen.bmj.com/content/1/2/e000109.full>

562 SUN(Scaling Up Nutrition),2010.Scaling Up Nutrition:A Frame work for Action
 563 ,Accessedonlineat:http://www.unscn.org/en/nutworking/scaling_up_nutrition_purpose
 564 .php.