

## **CLIMATE CHANGE : EFFECTS ON PUBLIC HEALTH IN BANGLADESH: ANALYSIS AND RECOMMENDATION**

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### **INTRODUCTION**

There is a strong and growing, global, scientific consensus that the earth is warming, due to emissions of greenhouse gases (GHGs) caused by human activities.<sup>1</sup> It is also clear that current trends of energy use, development activities and population growth will lead to continuous and more severe climate change(CC). Climate of the earth is not static, and has changed many times in response to a variety of natural causes. In recent years the earth has experienced increasing global warming due to natural causes and human activities as well.

As humans emit more Carbon Dioxide (CO<sub>2</sub>) and other greenhouse gases into the atmosphere, the greenhouse effect becomes stronger and causes the earth's climate to change unnaturally due to rise of temperature. As depicted in the Human Development Report 2007/2008 "Global warming is already happening. World temperatures have increased by around 0.7<sup>o</sup>C since the advent of the industrial era and the rate of increase is quickening".<sup>2</sup> Human is the main driver of CC as revealed by the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). As an environmental problem, CC will generate number of health problems along with social and economic problems for a vast majority of the world's population.

### **Understanding Climate and Climate Change**

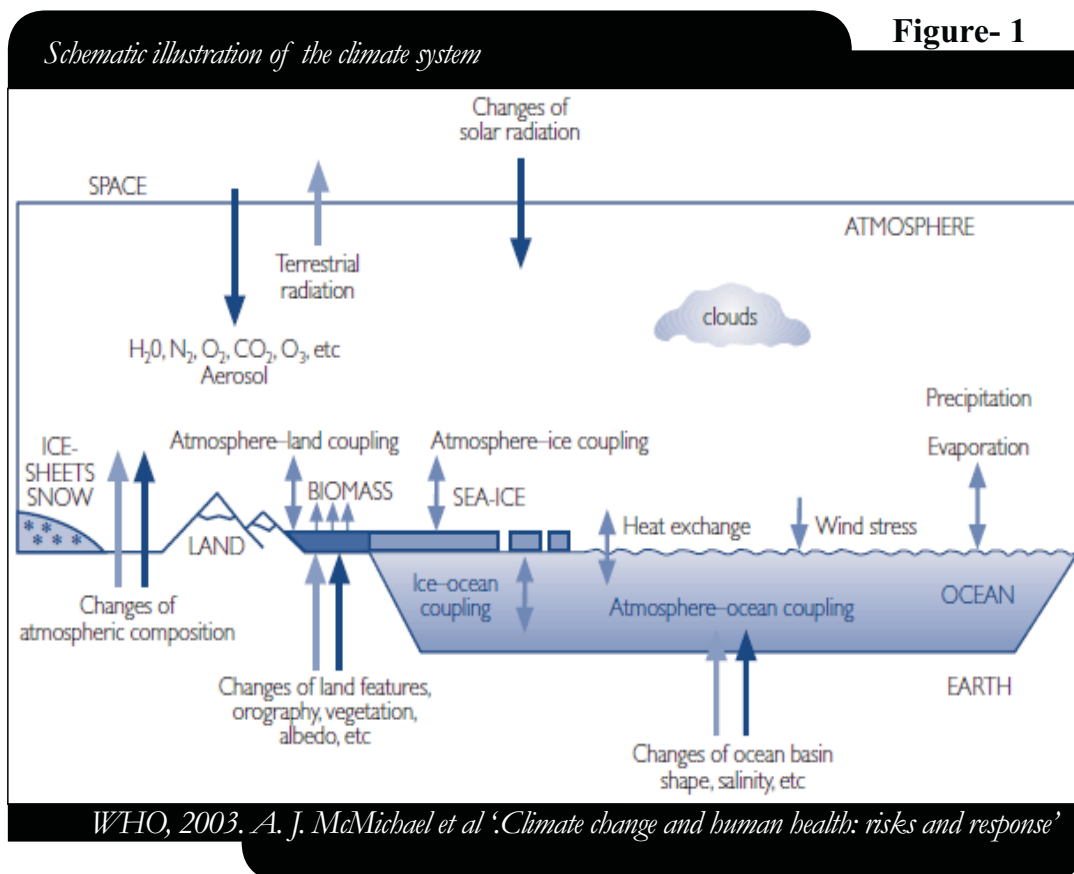
Climate (from Ancient Greek *lima*, meaning *inclination*) is commonly defined as the weather averaged over a long period of time. The standard averaging period is 30 years, but other periods may be used depending on the purpose. The IPCC glossary definition is:

*Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface*

1. WHO,2009' Protecting Health from Climate Change :Connecting science, Policy and People', p.2
2. *Bangladesh: Capacity Development Action Plan for Sustainable Environmental Governance*, Government of the People's Republic of Bangladesh, December 2007, p. 19

variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system<sup>3</sup>

The difference between climate and weather is usefully summarized by the popular phrase “Climate is what you expect, weather is what you get.” Figure-1 depicts schematic illustration of the climate system



### Climate Change phenomenon

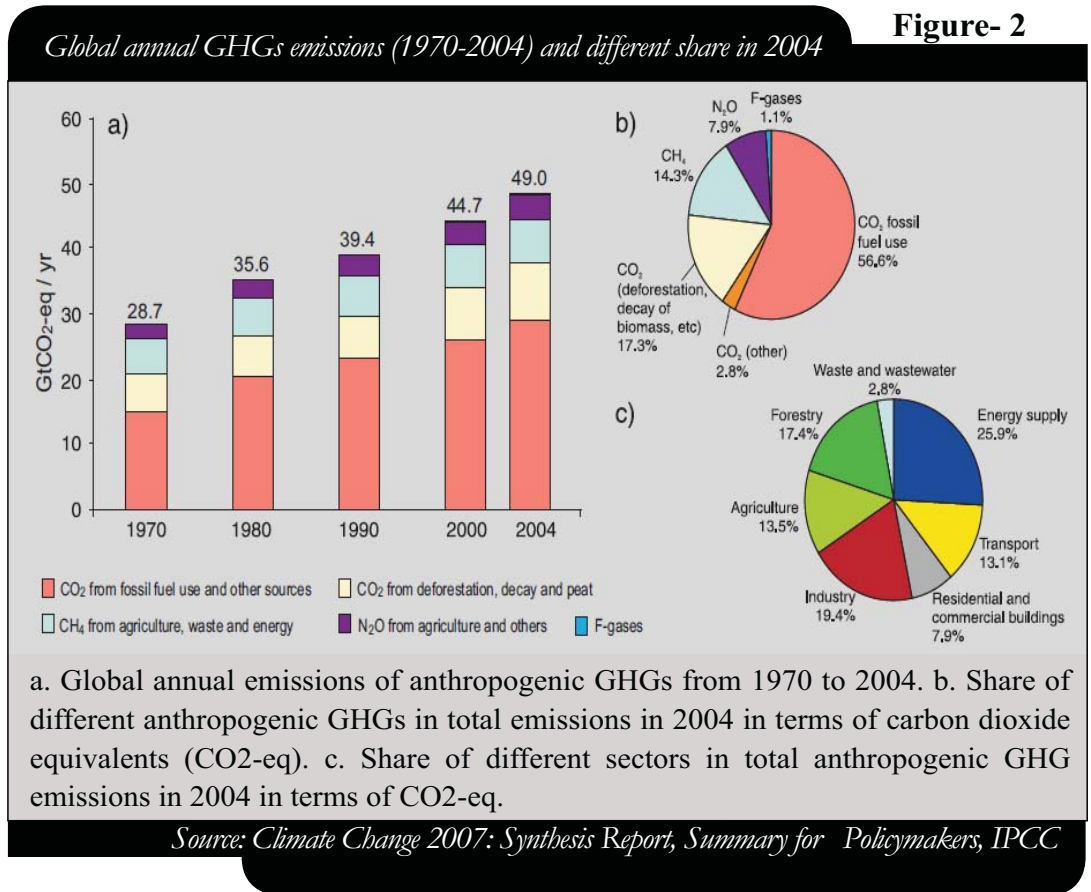
In generic sense, CC refers to shifts in temperature that have happened over the last 100 years. The United Nations Framework Convention on Climate Change (UNFCCC) defines CC as “a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”<sup>4</sup> The UNFCCC uses the term CC to mean only those changes that are brought about by human activities. According to the AR4 of the Working Group III of IPCC, CC refers to any change in climate over time, whether due to natural variability or as a result of human activity.

3. Intergovernmental Panel on climate change Appendix I: Glossary 2007.

4. WHO, 2003. 'Climate Change & Human Health – Risks and Responses (Summary)' p. 32

**The Greenhouse Gases Effect**

The Greenhouse Effect is a natural process through which various gases and water vapour in the atmosphere affects the earth’s climate. It is so named because it acts like a glass greenhouse for plants by preventing the incoming heat from the sun from leaving causing warming of the earth just as the inside of a greenhouse warms.<sup>5</sup> These GHGs comprise, principally, carbon dioxide, plus other heat-trapping gases such as methane (from irrigated agriculture, animal husbandry and oil extraction) nitrous oxide and various human-made halocarbons.<sup>6</sup> (Figure-2).



**Climate Change Effect in Bangladesh**

Bangladesh is situated at the boundary of two contrasting settings with the Bay of Bengal and the North Indian Ocean to the south and the Himalayas to the north. The geographical location, low and almost flat topography, very high population density, etc. have made Bangladesh one of the world’s most

5. Pender, J.S. 2008. ‘What is Climate Change? And How it may affect Bangladesh’. Briefing Paper. Dhaka, Bangladesh: Church of Bangladesh Social Development Programme.p. 9  
 6. Climate Change 2007: Synthesis Report, Summary for Policymakers, IPCC. p. 5

vulnerable countries to be affected by the global warming and CC. The CC effects in Bangladesh are discussed in the subsequent paragraphs.

### Flooding

Bangladesh is a deltaic country with an area of 144,900 sq. km most of which is basically the floodplain of the three greatest rivers of the world - the Ganges, the Brahmaputra and the Meghna (GBM).<sup>7</sup> Bangladesh is one of the world's most flood-prone countries. About one-fifth to one-third of the country is flooded by overflowing over to varying degrees during monsoon each year. Following table shows serious floods in the country in the last 25 years with their impact:

<b>Event</b>	<b>Impact</b>
1984 flood	Inundated over 50,000 sq. km, estimated damage US \$ 378 million.
1987 flood	Inundated over 50,000 sq. km, estimated damage US\$ 1 billion, 2,055 deaths.
1988 flood	Inundated 61% of the country, estimated damage US\$ 1.2 billion, more than 45 million homeless, between 2,000-6,500 deaths.
1998 flood	Inundated nearly 100,000 sq.km. rendered 30 million people homeless, damaged 500,000 homes, heavy loss to infrastructures, estimated damage US\$ 2.8 billion, 1,100 deaths.
2004 flood	Inundated 38%, damage US \$ 6.6 billion, affected nearly 3.8 million people, 700 deaths.
2007 flood	Inundated 32,000 sq.km, over 85,000 houses destroyed and almost 1 million damaged, approximately 1.2 million acres of crops destroyed or partially damaged, estimated damage over US\$1 billion, 649 deaths.

*Source: BCCSAP 2009, Ministry of Environment and Forests GOB, p-09*

### Tropical Cyclones and Storm Surges

Severe tropical cyclone hits Bangladesh, on average, every 3 years. These storms generally form in the months just before and after the monsoon and intensify as they move north over the warm waters of the Bay of Bengal. Table-2 illustrates the effects of cyclones/floods from 1970 to 2007 in Bangladesh.

7. 'Impact Assessment of Climate Change and Sea Level Rise on Monsoon flooding ' Climate Change Cell, Department of Environment, Government of the People's Republic of Bangladesh (published in association with DFID and UNDP June 2009).

**Table-2**

*Direct Effects of major Cyclones/Floods in Bangladesh*

Direct Effects Major Cyclone/Floods in Bangladesh			
Hazard	Year	Death (No.)	Economic loss (Billion USD)
Cyclone*	1970	300,000	2.40
	1991	138,882	1.50
	2007	3,406	1.60
Flood	1988	2,379	1.20
	1998	918	2.80
	2004	285	2.20
	2007	707	1.06

\* Category 4 Cyclone

*Source: Disaster Management and Relief Division, MoF&DM*

**Heavier/Lower and More Erratic Rainfall**

Heavier and more erratic rainfall in the GBM basin during the monsoon will result in higher river flows, causing over-topping and breaching of embankments and widespread flooding in rural and urban areas. Due to heavy rainfall there will be river bank erosion and increase sedimentation in riverbeds leading to drainage congestion and water logging.<sup>8</sup> On the other hand lower & erratic rainfall will result in increasing droughts, especially in drier northern and western regions of the country.

**Temperature**

This rise of temperature will affect public health. People could be affected by climate change’s impact on disease, and a number of diseases in Bangladesh may become more common due to hotter weather.

**River Bank Erosion**

Climate change is likely to increase rainfall in the GMB basin in the monsoon season. This will result in higher river flows and possibly increased velocities. This is likely to cause further instability in the already unstable river system resulting river bank erosion. According to an estimate of Bangladesh Water Development Board, 1200 km of river bank has already eroded and another 500 km is prone to erosion. Climate change accelerates the process further.<sup>9</sup>

8. Pender, J.S. 2008. ‘What is Climate Change? And How it may affect Bangladesh’. Briefing Paper. Dhaka, Bangladesh: Church of Bangladesh Social Development Programme. p. 30

9. ‘Climate Change & Vulnerability of Bangladesh’ Climate Change Cell, Department of Environment, Government of the People’s Republic of Bangladesh (published in association with DFID and UNDP , 2009).

### **Saline Water Intrusion**

The impact of CC on physical system in combination with the effect of sea level rise would cause a net increase in salinity in the already affected soils in the coastal regions of Bangladesh. Coastal waters will become more saline and soil salinity will increase.<sup>10</sup> This will result reduction of net available cultivable land.

### **Drought**

Already climate change is thought to be increasing the numbers of droughts for there were only five devastating droughts in the hundred years from 1800 to 1900, yet since 1981, four major droughts have occurred in the last 25 years mostly in north-western Bangladesh.<sup>11</sup> During the dry period (November to May) about 2.7 million hectares of land in Bangladesh are vulnerable to annual drought.

### **Sea Level Rise**

If sea level rise reaches the one meter mark by 2100 over 10% of Bangladesh lies below this height. Bangladesh has been ranked as the 3rd most vulnerable in the world to sea level rise in terms of the number of people and in the top ten in terms of percentage of population living in the low elevation coastal zone. Sea level rise could potentially force around 33 million of their land by 2050 and up to 43 million of their land by 2080 and this is only taking into account the direct effect of sea level flooding.

### **Effects on Agriculture**

Climate change is likely to seriously affect agriculture (crops, livestock and fisheries). The higher temperatures and changing rainfall patterns, coupled with increased flooding, rising salinity in the coastal belt and droughts are likely to reduce crop yields and crop production. IPCC estimates that, by 2050, rice production in Bangladesh could decline by 8% and wheat by 32%.<sup>12</sup>

### **Safe Drinking Water**

Shortage of safe drinking water is likely to become more pronounced, especially in the coastal belt and in drought-prone areas in the north-west of the country. This will impose hardship on women and children, who are responsible for collecting drinking water for their families. Increasingly saline drinking water may also result in health hazards.<sup>13</sup>

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10. Ibid

11. Pender, J.S. 2008. 'What is Climate Change? And How it may affect Bangladesh'. Briefing Paper. Dhaka, Bangladesh: Church of Bangladesh Social Development Programme. p. 35

12. Climate change & vulnerability of Bangladesh, *op. cit.*

13. Climate Change & Water' Climate Change Cell, Department of Environment, Government of the People's Republic of Bangladesh (published in association with DFID and UNDP, 2009).

## **Food Security and Livelihood**

The effects of climate change will threaten the food security and livelihood of the poor. People living on river islands and along the coastline, are among the poorest people in the country. They will be seriously affected, as will others who lose their land to river erosion. Climate change is likely to threaten food security of Bangladesh.<sup>14</sup>

## **Environmental Refugees**

It has been estimated that there is the impending threat of displacement of more than 20 million people in the event of sea-level change and resulting increase in salinity coupled with impact of increase in cyclones and storm surges, in the near future. The settlement of these environmental refugees will pose a serious problem for the densely populated Bangladesh and migration must be considered as a valid option for the country.

## **Adverse Effect of Climate Change on Public Health**

**Impacts on Basic Determinants of Health.** Climate change will have a number of serious health-related impacts on the population of Bangladesh. The 4<sup>th</sup> IPCC report indicates that one of the major impacts of global warming and climate will be an increase in vector borne diseases (malaria and dengue fever). Further climate change will also affect, in profoundly adverse ways, some of the most fundamental pre-requisites for health: clean air and water, sufficient food, adequate shelter and freedom from disease.<sup>15</sup>

## **Climate Change Effects on Human Health**

Change in world climate would influence the functioning of many ecosystems and their member species. Likewise, there would be impacts on human health. AR4 of IPCC shows that CC has:

- a. altered the distribution of some infectious disease vectors;
- b. altered the seasonal distribution of some allergenic pollen species; and
- c. increased heat wave-related deaths

The evidence so far published indicates that:

- a. CC is affecting the seasonality of some allergenic species as well as the seasonal activity and distribution of some disease vectors;

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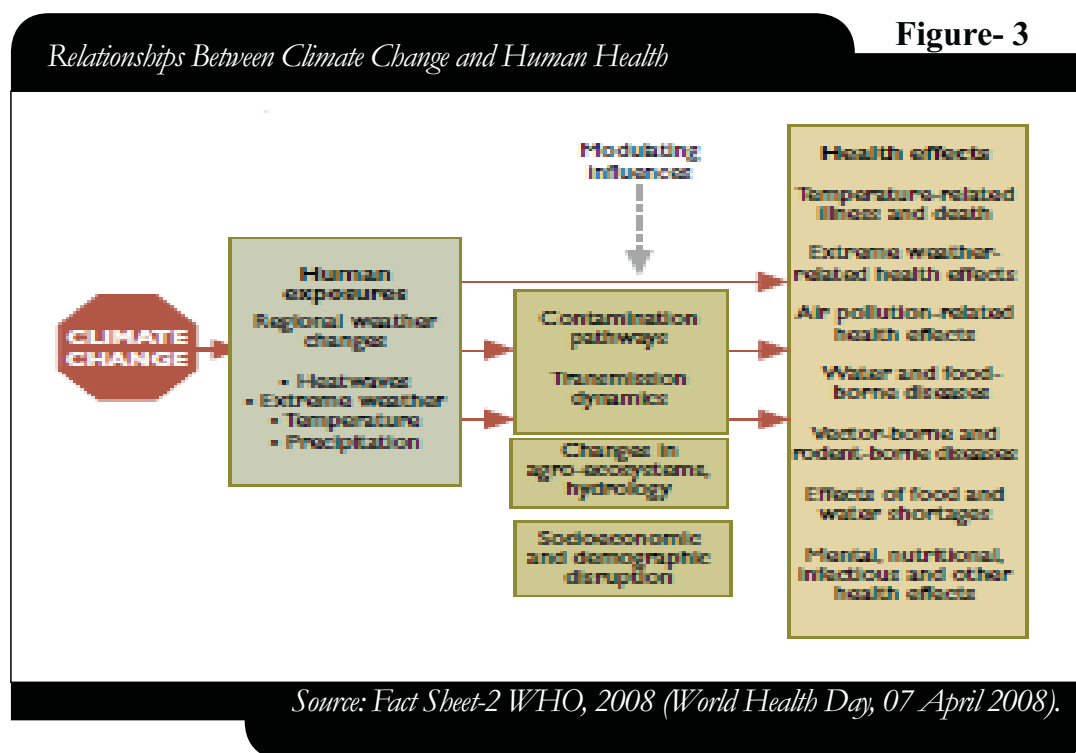
14. Climate Change & Food Security' Climate Change Cell, Department of Environment, Government of the People's Republic of Bangladesh (published in association with DFID and UNDP , 2009).

15. WHO, 2009' Protecting Health from Climate Change : Connecting science, Policy and People', p. 6

- b. climate plays an important role in the seasonal pattern or temporal distribution of malaria, dengue, tick-borne diseases, cholera and other diarrhoeal diseases; and
- c. heat waves and flooding can have severe and long-lasting effects.

### Relationship Between Climate Change and Human Health

Climate change affects human health both directly and indirectly. People are exposed directly to changing weather patterns (temperature, precipitation, sea-level rise and more frequent extreme events) and indirectly through changes in the quality of water, air and food, and changes in ecosystems, agriculture, industry, human settlements and the economy.<sup>16</sup> . The relationship between climate change and human health is multidimensional, as shown in Figure-3.



### Temperature Related Illness

The health impacts associated with heat waves are heat stroke, heat cramps, heat exhaustion deaths related to heat waves, prevalence of diarrhoeal diseases, dehydration and aggravation of cardiovascular diseases in elderly people.<sup>17</sup>

16. Atiq Rahman, 2008. 'Climate change and its impact on health in Bangladesh'. Regional Health Forum- Volume-12, November 1, 2008

17. Ibid.



### **Diseases Due to Air pollution & Respiratory Problems**

Because of CC smog (ground-level ozone) levels are expected to increase as temperatures rise. Smog can irritate the respiratory system, reduce lung capacity, and aggravate asthma. People with existing respiratory or heart problems would be at increased risk.<sup>18</sup>

### **Problems Due to Variable Precipitation Patterns**

Changes in precipitation patterns are likely to compromise the supply of fresh water, thus increasing the risk of waterborne diseases. They are also associated with floods and waterlogging that increase the incidence of diarrhoea, cholera and skin and eye diseases.<sup>19</sup>

### **Water and Food Borne Diseases**

Diseases such as Cholera and Typhoid, which are transmitted through contaminated food or water, could become more widespread with climate change because of increased flooding. This may result from human actions, such as improper disposal of sewage wastes, or may be due to weather events. Rainfall can influence the transport and dissemination of infectious agents, while temperature affects their growth and survival.

### **Effects of Food Shortages**

Rising temperatures and variable precipitation are likely to decrease agricultural production, thereby increasing the risk of malnutrition. Malnutrition will further increase the vulnerability of those affected people to infectious and water- and vector-borne diseases.

### **Vector-borne Diseases**

Changes in climate are likely to lengthen the transmission seasons of important vector-borne diseases, and alter their geographic range. Already, dengue is a regular disease in the major cities of Dhaka and Chittagong. Important determinants of vector-borne disease transmission include:

- a. vector survival and reproduction
- b. vector's biting rate and
- c. pathogen's incubation rate within the vector organism.

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18. US Environmental Protection Agency, April 2010. 'Climate Change and Health Effect' available at [www.epa.gov/climatechange](http://www.epa.gov/climatechange)

19. Atiq Rahman, 2008. 'Climate change and its impact on health in Bangladesh'. Regional Health Forum- Vol. 12, 1 November 2008.

### Climate Sensitive Diseases

There is much evidence of associations between climatic conditions and infectious diseases. Particularly vector-borne diseases are most sensitive to long-term climate change. Excessive monsoon rainfall and high humidity was identified to have a major influence, enhancing mosquito and other vector breeding and survival. Examples of climate sensitive diseases are shown in table-3.

<i>Examples Climate Sensitive Diseases</i>		<b>Table- 3</b>
<b>Environmental change</b>	<b>Example disease</b>	<b>Pathway of effects</b>
Dams, canals, irrigation	Schistosomiasis	Snail host habitat, human contact
	Malaria	Breeding sites for mosquitoes
	Helminthiasis	Larvacontact due to moist soil
	River blindness	Blackfly breeding, Disease
Agricultural intensification	Malaria	Crop insecticide and Vector resistance
	Venezuelan haemorrhagic fever	Rodent abundance, contact
Urbanization, urban crowding	Cholera	Sanitation, hygiene, Water contamination
	Dengue	Water-collecting trash, Aedes aegypti mosquito breeding sites
	Cutaneous leishmaniasis	Proximity, sandfly vectors
Deforestation and new habitation	Malaria	Breeding sites and vectors, immigration of susceptible people
	Oropouche	Contact, breeding of vectors
	Visceral leishmaniasis	Contact with sandfly vectors
Reforestation	Lyme disease	Tick hosts, outdoor exposure
Ocean warming	Red tide	Toxic algal blooms
Elevated precipitation	Rift valley fever	Pools for mosquito breeding
	Hantavirus pulmonary syndrome	Rodent food, habitat, abundance

*Source :Wilson.M.L. 'Ecology and infectious diseases in Ecosystem Change and Public Health: A Global Perspective', John Hopkins University Press: Baltimore, 2001.*

### **Effects due to Rising Sea Levels**

Rising sea levels increase the risk of coastal flooding, and may necessitate population displacement, and cause many other health-related problems such as cholera, diarrhoea, malnutrition and skin diseases, etc.

### **Allergic Diseases**

Climate change could also cause more severe allergy symptoms because a warmer climate is expected to promote the growth of the molds, weeds, grasses, and trees that cause allergic reactions in some people. Climate change has already caused the spring pollen season to begin earlier in North America. Ragweed has been observed to grow faster and flower earlier in urban areas where effects of climate change are enhanced compared with rural areas.<sup>20</sup>

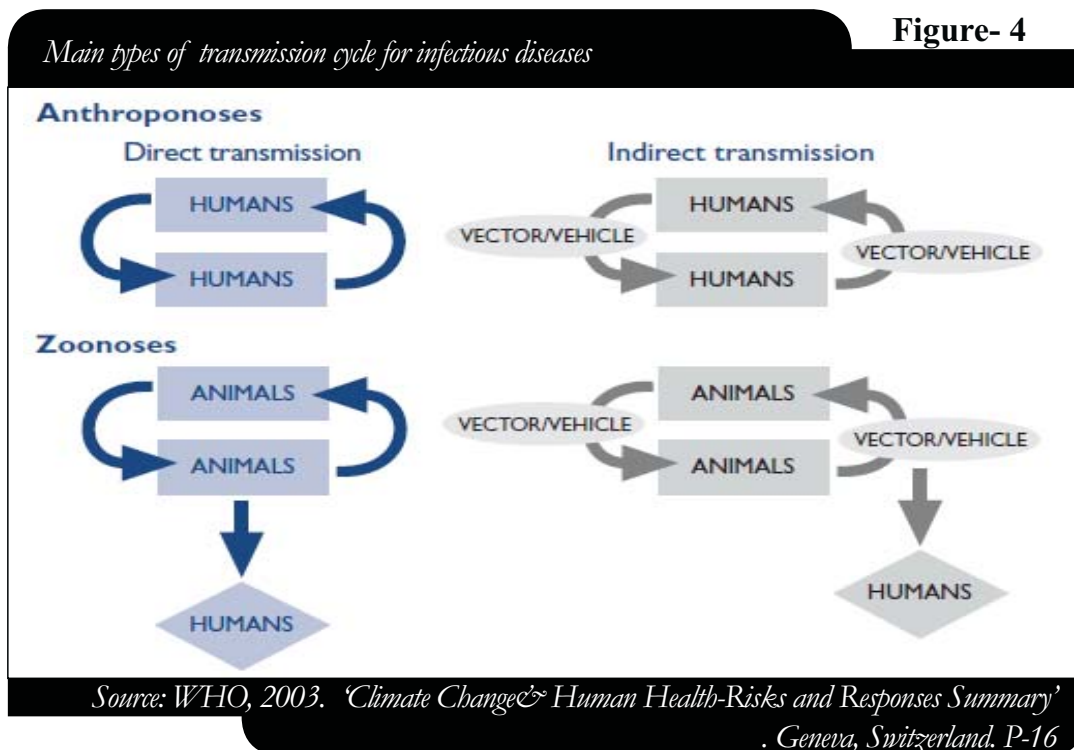
### **Burden and Distribution of Diseases and Changing Patterns of Infections Transmission of Diseases**

Infections caused by pathogens that are transmitted by insect vectors are strongly affected by climatic conditions such as temperature, rainfall and humidity. These diseases include some of the most important current killers: malaria, dengue and other infections carried by insect vectors, and diarrhoea, transmitted mainly through contaminated water.<sup>21</sup> There are four main types of transmission cycle for infectious diseases as shown in figure-4

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20. US Environmental Protection Agency, April 2010. 'Climate Change and Health Effect' available at [www.epa.gov/climatechange](http://www.epa.gov/climatechange)

21. WHO, 2009. 'Protecting health from Climate change: Connecting science, policy and people.' WHO, 2009, Geneva, Switzerland.



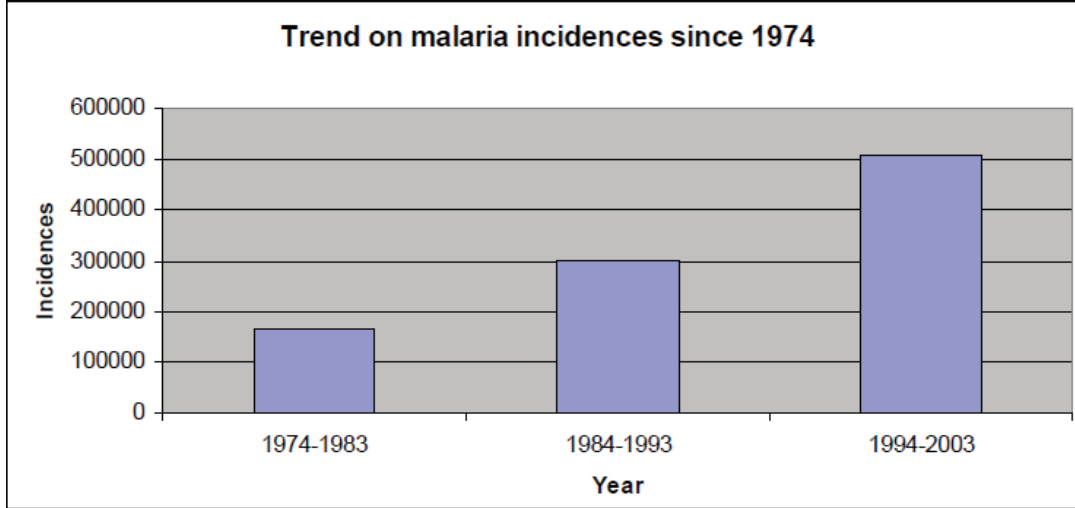
## Malaria

Malaria distributions are strongly affected by CC. Transmitted by *Anopheles* mosquitoes, malaria is the most important vector-borne cause of mortality globally. It kills almost 900 thousand people each year, mainly poor children in Africa. Malaria is strongly influenced by climatic conditions; it is not transmitted in the cooler temperatures associated with high altitudes and latitudes., Warmer temperatures, higher humidity and more places where water can collect generally favour malaria transmission.<sup>22</sup> Over 10 million people in the Chittagong Hill Tracts and similar areas are at risk of malaria. Figure-5 shows trend of Malaria in Bangladesh since 1974.

22. WHO, 2009. 'Protecting health from Climate change: Connecting science, policy and people.' WHO, 2009, Geneva, Switzerland

*Trend of Malaria in Bangladesh since 1974*

**Figure- 5**



*Source: Climate Change Cell, DoE. 'Climate Change and Health Impacts in Bangladesh' June, 2009*

**Dengue**

Dengue is expanding rapidly. Transmitted by *Aedes* mosquitoes, dengue is a fast growing health challenge. Like Malaria, the distribution of Dengue is also highly dependent on climate.<sup>23</sup> Incidence of Dengue and other climate sensitive diseases in Bangladesh during last few decades is shown in the following table.

*Incidence of some of the major climate-sensitive diseases in Bangladesh.*

**Table- 4**

Disecises	Total cases per period	Period	Average annual cales
Diarrhoea	48302636	1988–2005	2842273
Skin diseases	23697833	1988–1996	2623092
Malaria	1018671	1974–2004	33956
Mental disorders	201881	1988–1996	22431
Dengue	19830	1999–2005	3305

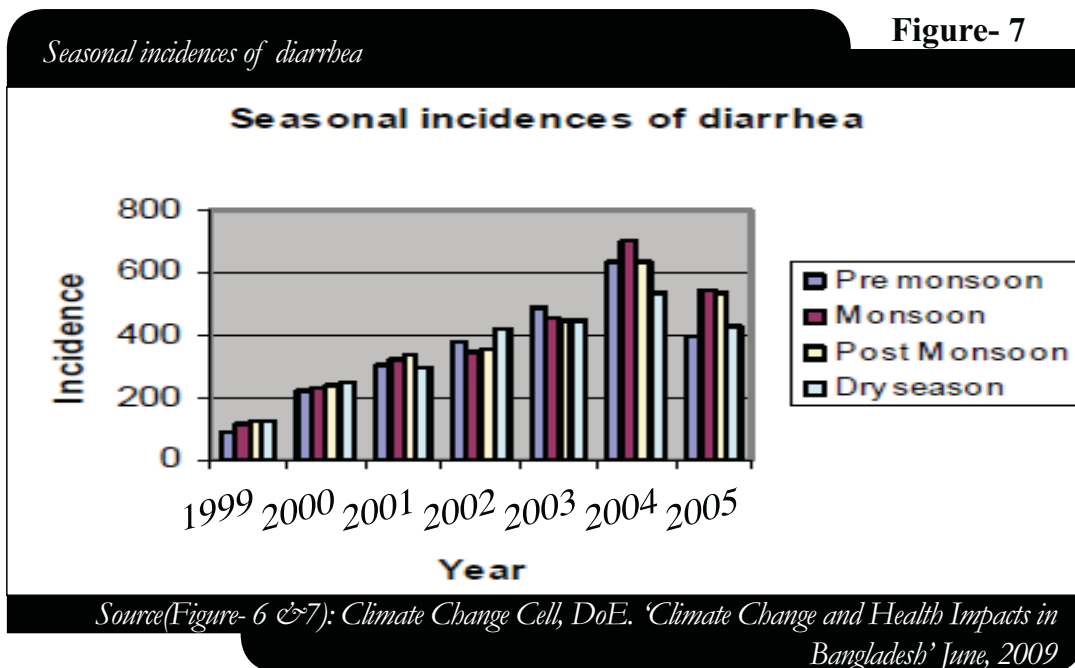
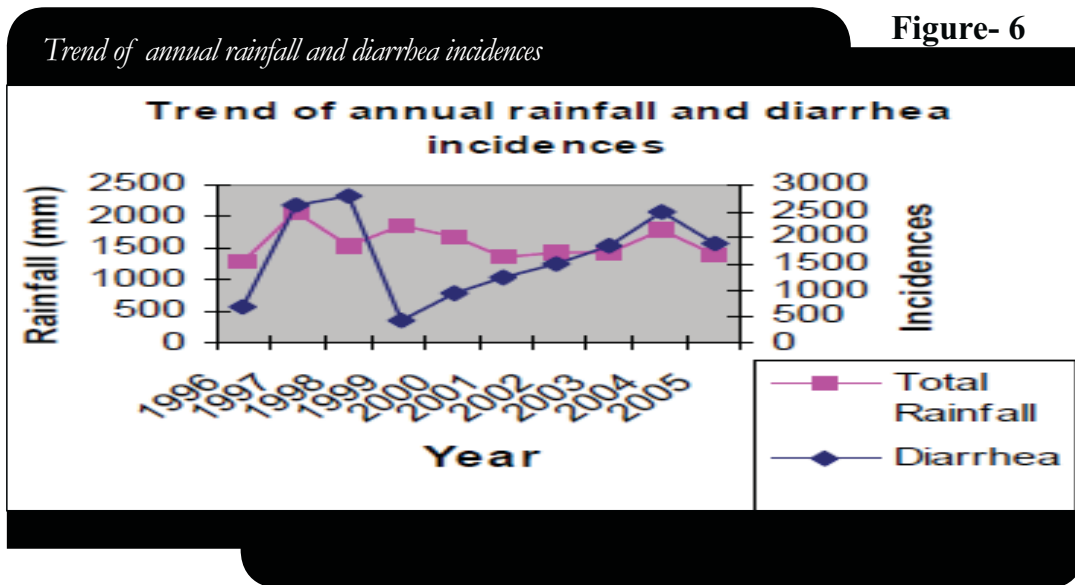
*Source: Data modified from WHO, 2006; Director-General, Health; 1996, 1997; MoEF, 2005*

**Diarrhoeal Diseases**

Diarrhoeal diseases remain as one of the biggest killers particularly for children. Viruses and bacteria transmitted through water and contaminated

23. Ibid.

food can cause severe diarrhoea in children. In countries with inadequate water and sanitation services, diarrhoea is much more common when temperatures are high.<sup>24</sup> Recent studies by the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR, B) demonstrate that diarrhoeal diseases increase, with the increase of rainfall. (Illustrated in Figure-6 & 7).



24. Ibid.

Research also shows that there is definite correlation between climatic parameters and some diseases in Bangladesh. Table-5 illustrates this fact.

**Table- 5**

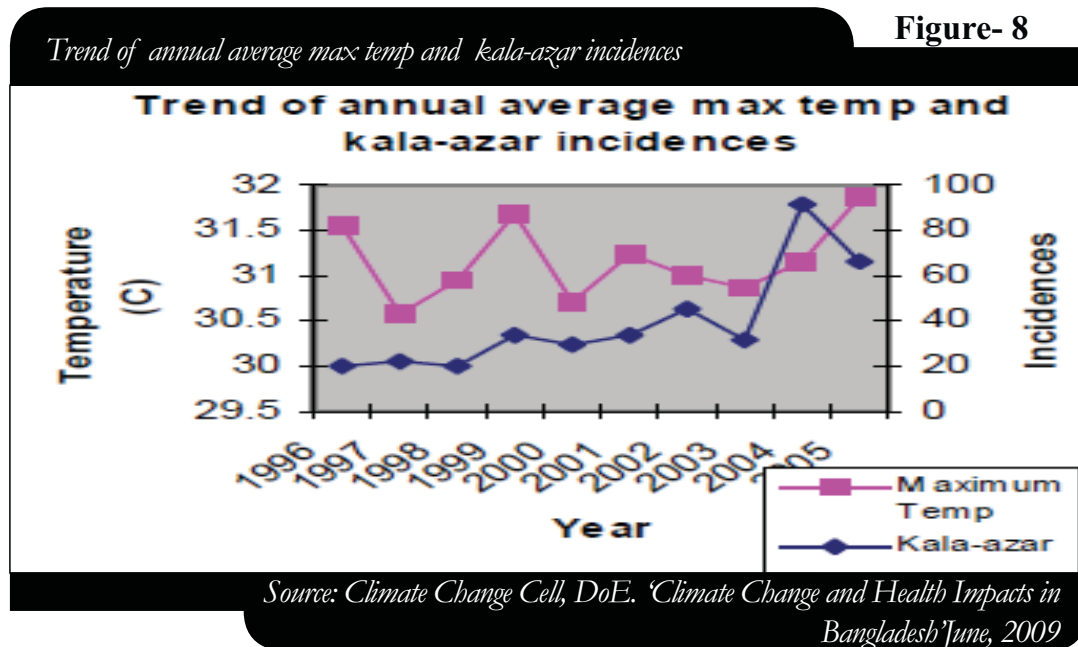
*Correlation between climate parameters and some diseases in Bangladesh*

Diseases	Climatic Connections
Cholera	Positively correlated with temperature rise and shiny day
Malaria	Associated with temperature rise
Dengue	Associated with temperature rise
Kala-azar	Associated with temperature rise

*Source: ICDDR, 2007; NIPSOM, 2007; BCAS.2007*

**Kala-azar**

Kala-azar has reemerged in Bangladesh since the cessation of dichlorodiphenyl-trichloroethane (DDT) spraying operations. At least 20 million people in more than 27 districts of Bangladesh are at risk. The estimated cumulative disease-specific burden is 35000 cases.<sup>25</sup> Figure-8 illustrates the trend of kala-azar incidences and annual average temperature.



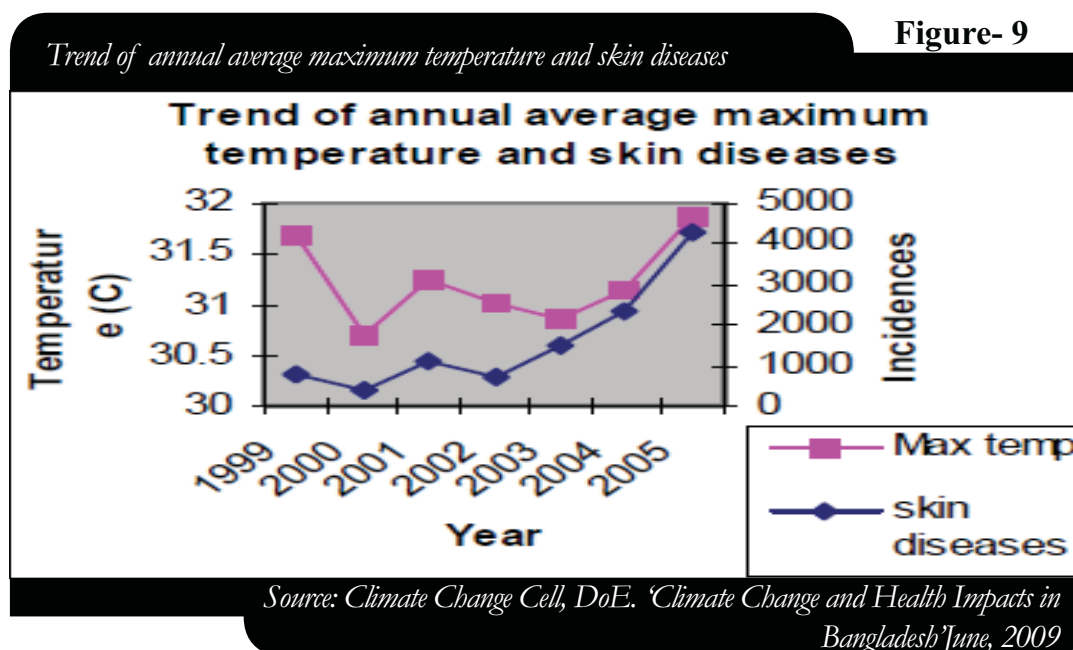
25. Atiq Rahman, 2008. 'Climate change and its impact on health in Bangladesh'. Regional Health Forum- Volume-12, November 1, 2008.

## Filariasis

Filariasis is caused by nematode worms (*W.bancrofti*, *B.malayi* & *B.timori*). All three infections are transmitted to the man by the bites of infective mosquitoes (mainly *Culex*) Climate is an important factor in the epidemiology of Filariasis. The maximum prevalence was observed when the temperature was between 22 to 38 degree C.<sup>26</sup>

## Skin Diseases

In a study carried out by BCAS and NIPSOM supported by Climate change cell skin diseases were found to be positively correlated with temperature differential (difference between maximum and minimum temperature based on daily records per year) in both Rajshahi and Satkhira.<sup>27</sup> (Table-4 & Figure-9).



## Malnutrition

Malnutrition and under nutrition and related disease is currently the greatest contributor to the global burden of disease, killing an estimated 3.5 million people per year, mostly children in developing countries.<sup>28</sup> In Bangladesh malnutrition was found to have highest occurrences during post-monsoon in early years of the last decade while it was highest in monsoon during 2nd half of the last decade. Study reveals that Malnutrition incidences were also found to have positive correlation (+0.03)<sup>29</sup> ( figure-10).

26. K.Park, Park's 'Text Book of Preventive and Social Medicine' 20 th edition, 2009.

27. Climate Change Cell DoE. 'Climate Change and Health Impacts in Bangladesh' June, 2009

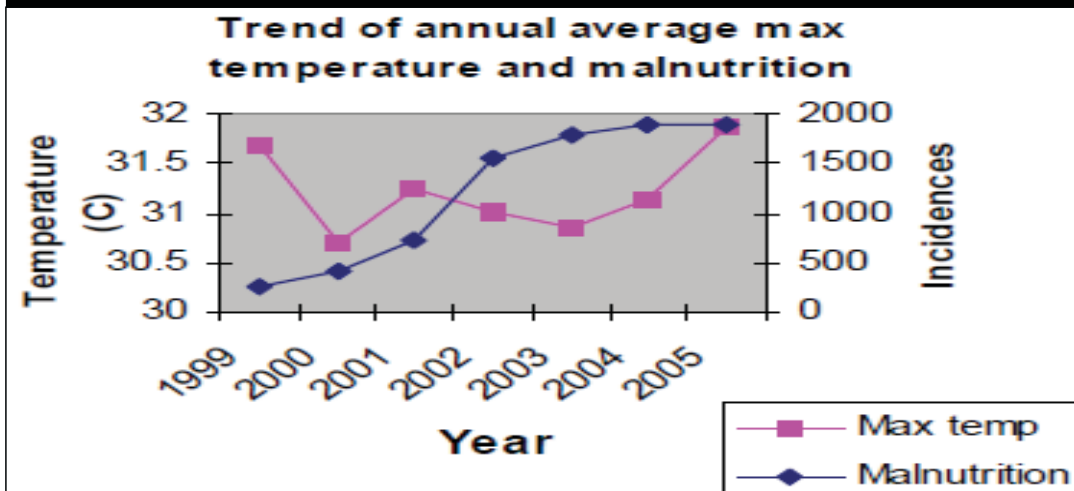
28. WHO, 2009' Protecting Health from Climate Change :Connecting science, Policy and People',

29. Climate Change Cell, DoE. 'Climate Change and Health Impacts in Bangladesh' June, 2009



**Figure- 10**

*Trend of annual average maximum temperature and malnutrition*



*Source: Climate Change Cell, DoE. 'Climate Change and Health Impacts in Bangladesh'*

*June, 2009*

**New & Unfamiliar Diseases**

Some infectious disease once thought to be conquered have returned with a vengeance. New and previously unknown diseases continue to emerge. Increased exposure of humans to disease vectors and reservoirs of infection in nature is one of the factors responsible for that. Any disease caused, transmitted or harboured by insects, snails and other cold-blooded animals can be affected by a CC. However, studies are required to find out the correlation with CC.

**Vulnerable Population Due to Climate Change**

All populations will be affected by a changing climate, but the initial health risks vary greatly. Health effects are expected to be more severe for elderly people, individuals without adequate shelter and people with infirmities or pre-existing medical conditions. The groups who are likely to bear most of the resulting disease burden are children and the poor, especially poor women.

**Bangladesh Climate Change Strategy and Action Plan (BCCSAP)s**

In 2005, the Government of Bangladesh developed the National Adaptation Programme of Action (NAPA) after extensive consultations with communities across the country, professional groups; and other members of civil society. Subsequently, the Government has developed the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 which was revised in 2009 as BCCSAP 2009 to address adverse effects of climate change including variability

and extreme events based on existing coping mechanisms and practices. The BCCSAP 2009 is based on six pillars. They are:

- a. food security, social protection and health,
- b. comprehensive disaster management,
- c. infrastructure,
- d. research and knowledge management,
- e. mitigation and low carbon development and
- f. capacity building and institutional strengthening

There are 44 programmes in the strategy which will be implemented under overall guidance of the National Environment Committee, chaired by the Honorable Prime Minister. GOB has recently established a National Climate Change Fund with initial capitalization of \$45 million which later on raised to \$100 million. This will mainly focus on various adaptation measures. Adaptation to CC will place a massive burden on Bangladesh's development budget. So international and regional support will be required to face these challenges. GOB expects that all development partners will contribute to this fund and offer all possible support in this regard.

## **RECOMMENDATIONS**

### **National**

1. Diarrhoea & other waterborne diseases and most of the climate –sensitive diseases are major public health problems in Bangladesh. To address these problems strengthening of institutional capacity needs to be considered on an urgent basis.
2. Government agencies should initiate surveillance measures for climate sensitive diseases separately and develop a dataset for climate-sensitive diseases, as well as vector data based on geographical distribution to facilitate further research and prediction.
3. Health professionals need to be trained on prompt diagnosis and proper management of the climate change related diseases.
4. The government should initiate training programmes on different awareness raising activities highlighting the CC impacts on human health and improvement hygienic practices.
5. Water supply and sanitation management should be improved by protecting water resources and involving Public Health Engineering Department.
6. Government needs to strengthen the research activities to find out the changes in infectious disease transmission patterns of the climate sensitive diseases.

7. Food security, health and social protection to the poorest and most vulnerable in society, including women and children, are to be ensured.
8. Comprehensive Disaster Management systems need to be further strengthened to deal with increasingly frequent and severe natural calamities as per the guidelines mentioned in BCCSAP 2009.

### **Regional**

9. Establishment of regional platform and initiation of a process and mechanism within SAARC member countries to address climate change issues focusing the problems related to climate-sensitive diseases collectively and develop a proposal for collective action.

### **Global**

10. Global community should advocate for a strong and equitable post-Kyoto Agreement and promote a “health-oriented” agreement. Protecting health and well-being should be one of the main objectives of the new agreement.

### **World Health Organization**

11. Should provide specific climate change–related technical guidance for vulnerability and adaptation assessments and surveillance systems to quantify the disease burden;
12. Should facilitate greater contribution of fund from donor agencies for climate change health related programme;
13. Should support Bangladesh technically, financially and by providing training to build national capacities;
14. Should develop and provide technical guidance on good adaptation and GHG emission reduction practices within the health sector; and
15. Should establish national & regional WHO collaborating centers on climate change and health.

### **CONCLUSION**

Global warming has affected weather patterns and disrupted the variability and trends in climate. This is resulting in an increase in CC related to extreme events like increased temperature, heavy rainfall, drought, flood, cyclones, storm surges, SLR etc. The changing climate inevitably affects the basic determinants and some of the most fundamental pre-requisites for health: clean air and water, sufficient food, adequate shelter and freedom from diseases. CC also alters the

distribution of some infectious disease vectors, the seasonal distribution of some allergenic pollen species and increases heat wave-related sickness including deaths.

The unique geographical location, low and almost flat topography, very high population density, etc. have made Bangladesh one of the world's most vulnerable countries to be affected by CC. In particular, the coastal areas of the country are more vulnerable. Bangladesh is already facing the harmful impacts of CC in the form of erratic rainfall, flooding, water logging, river bank erosion, tropical cyclones/storm surges, drought, saline water intrusion etc. .

CC affects human health both directly and indirectly. These direct and indirect exposures can cause death, disability and suffering. The major diseases that are most sensitive to climate change are diarrhoeal diseases including Cholera, vector-borne diseases like Malaria, Dengue, Filariasis, Kala-azar, infections associated with malnutrition and skin diseases. New and previously unknown diseases will continue to emerge. Increased exposure of humans to disease vectors and reservoirs of infection in nature due to CC is one of the factors responsible for that.

All populations will be affected by a changing climate, but the initial health risks vary greatly. Health effects are expected to be more severe for elderly people and people with infirmities or pre-existing medical conditions. The groups who are likely to bear most of the resulting disease burden are children and the poor, especially poor women.

Adaptive strategies intended to protect public health will be needed. Building capacity is an essential preparatory step. Against this backdrop GOB has developed BCCSAP 2009 to address adverse effects of climate change including variability and extreme events based on existing coping mechanisms and practices. Adaptation to CC will place a massive burden on Bangladesh's development budget. So international and regional support will be required to face these challenges.

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