People's Republic of Bangladesh
Health Services Division
Ministry of Health and Family Welfare

Climate Change and Health in Bangladesh

Training Curriculum
(For Health Managers)

Implemented By

Climate Change and Health Promotion Unit (CCHPU)
Health Services Division
Ministry of Health and Family Welfare

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Training Curriculum on Climate Change and Health in Bangladesh

For Health Officers/Managers at District/Upazilla level

Background

1. Context

Human health is severely undermined by climate change and climate variability in Bangladesh (UNICEF, 2019). The country is facing new challenges including increased incidences of climate sensitive diseases such as dengue, chikungunya, kalazaar, cholera, malnutrition and so on. Disease patterns are aggravating because of changes in both primary (e.g. temperature and rainfall) and secondary elements (drought, salinity intrusion, sea level rise, recurrent flood, flash flood) of climate change. After floods, cyclones and droughts waterborne diseases are more prevalent. The distribution and frequency of vector-borne diseases are changing due to temperature variations across various regions depending on the spatial and temporal dimensions. During extreme heat and extreme cold deaths and hospital admissions of children are increasing. Healthcare infrastructure and equipment are getting damaged and destroyed with disaster or extreme weather events, which disrupt healthcare services. The World Bank states that about 0.2 million people were killed by natural disasters during 1980-2010 in Bangladesh (World Bank, 2014). It indicates that about 6,188 people died each year during above-mentioned period due to disasters in the country. WHO (2015) estimates that by 2070 at least 117 million people will be at risk of malaria under a rapid emission reduction scenario, and this might be 147 million under a high emission scenario. Due to climate change around 19.4 million children are at risks in 20 out of 64 districts in Bangladesh (UNICEF, 2019). Currently (July-August, 2019), people of many Asian countries including Bangladesh, Malaysia, Singapore, Philippines, Cambodia, Laos, Vietnam are suffering from Dengue fever. In Bangladesh, incidences of dengue fever increased from 10,148 in 2018 to 49,999 in 2019 (The daily Star, 17 August 2019).

2. Course Introduction

The “Climate Resilient Health Systems for Vulnerable Women and Children of Bangladesh” project, a joint initiative of Climate Change & Health Promotion Unit (CCHPU) under the Ministry of Health and Family Welfare and United Nations Children’s Fund (UNICEF) is being implemented with support form Swedish International Development Cooperation Agency (Sida). The project intends to strengthen institutional capacity for climate resilient health systems strengthened and mainstreamed climate risks into health planning, policies and programming.

CCHPU and UNICEF decided to improve the capacity of government officials of the DG Health Services and other relevant stakeholders at both national and sub-national level for successful and effective adaptation to adverse effects of climate change. This course curriculum will mainly cover the science and concepts of climate change, impacts of climate change on human health, climate sensitive diseases profile in Bangladesh, responses to climate change and health at national and global level. The course curriculum will provide specific information needed at the national, district and Upazilla level to deal with climate sensitive diseases.

3. Objectives of the Training course curriculum

Poor and vulnerable people particularly in the costal region of Bangladesh are particularly affected by different disastrous climatic events such as tropical cyclones and associated storm surge, salinity intrusion in water and soil, erratic behavior of rainfall, temperature rise, droughts and other extreme weather events e.g. heat wave, cold wave. The main objective of the training is to improve understanding on climate change impacts on human health, current and required responses to deal with climate sensitive diseases in Bangladesh. However, the specific objectives of the training are:

- To enhance knowledge and understanding of the participants particularly health workforces at district/sub-district level regarding climate change and health aspects so that they can take leadership and improve governance on climate change and health adaptation in Bangladesh
- To contribute in building climate resilient health system in Bangladesh
- To gain basic understanding on climate change, implications of climate change on health and other sectors and adaptation issues

4. Training Course Curriculum

4.1 Introduction of the training course curriculum

The main focus of the course is to develop better understanding of the context, climate change impacts on human health, current and potential adaptation options to make the health system climate resilient in Bangladesh. CCHPU and UNICEF have reviewed the earlier relevant training manual of several countries e.g. China, Germany and course curriculum on “climate change and public health” of the World Health Organization (WHO) and a number of universities including University of Oxford, Yale University and Heidelberg University to draft the content of the training course curriculum for Bangladesh. The draft content of the course curriculum was shared with the national level stakeholders to get their feedback. CCHPU and UNICEF have revised the content of the curriculum based on the comments and suggestions from the consultative workshop held on 10 July 2019 at the conference room of Health Economic Unit, Ministry of Health and Family Welfare. The specific topics have been developed and a detailed course curriculum has been prepared. These are:

Module 1. Introduction to weather, climate, climate change and variability

- Concept and basics of weather, climate change, greenhouse effect climate variability
- Key terminologies: weather, climate, climate change, climate variability, greenhouse gases, greenhouse effect, heat island
- Global and national climate change induced hazards
- Climate Change Impacts in Bangladesh (In brief)

Module 2: Climate change and human health-global perspectives

- Introduction to climate change and human health
- Climate change sensitive diseases at the global level

- *Case Studies on Climate Sensitive Diseases/health disorders at the global level:*
- Case Study 1: Dengue fever in Americas Region, Asia, Africa and Australia and the Pacific
- Case study 2: Heat waves related health disorders
- Case study 3: Drought and health problems

Module 3: Climate change and human health in Bangladesh

- Introduction to climate change and human health in Bangladesh
- Climate sensitive diseases burdens in Bangladesh
- Climate Change Impacts in Human Health in Bangladesh
- Key Observations and projections on climate change impacts on human health in Bangladesh
- Climate change and water borne diseases
- Climate change and vector borne diseases
- Climate change and food borne diseases
- Climate change and air quality related diseases

Module 4: Climate change and Health – Current Responses at global level

- Key Policy/Strategy that address climate change and health at the global level
- United Nations Framework Convention on Climate Change (UNFCCC), 1992
- The Paris Agreement, 2015
- The Sendai Framework for Disaster Risk Reduction, 2015
- IPCC on adaptation options in Health Sectors
- WHO's Climate Resilient Health System

Module 5: National Adaptation Plan on climate change and health/H-NAP

- Key Policy/Strategy/Plan to address climate change and health in Bangladesh
  - ✓ National Adaptation Programmes of Action (NAPA), 2005
  - ✓ Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009
  - ✓ Seventh Five Year Plan (7FYP), 2016-2020
  - ✓ Third National Communication (TNC), 2016
  - ✓ Bangladesh Health Policy, 2011
- Key Institutions to deal with climate change impacts on health in Bangladesh
  - ✓ Ministry of Health and Family Welfare (MOHFW)
  - ✓ DG Health Services
  - ✓ Climate Change Health Promotion Unit (CCHPU)
  - ✓ Institute of Epidemiology, Disease Control and Research (IEDCR)

- ✓ Development of Climate Resilient Health System in Bangladesh

Module 6: Health and climate change in UNFCCC negotiation process

- Introduction to United Nations Framework Convention on Climate Change (UNFCCC)
- Health references" in UNFCCC Negotiation Process
- Suggested Health Adaptation Actions by UNFCCC
- Financial Support on Health Adaptation through different financial mechanism of UNFCCC

  - ✓ GEF (Least Developed Countries Fund/Special Climate Change Fund/GEF Trust Fund)
  - ✓ Green Climate Fund
  - ✓ Adaptation Fund

Module 7: Participant's follow up session/Post Training Action Plan

- Quiz questions to determine learning from the training sessions
- Feedback on the overall training
- Develop a "Follow Up Action Plan"

4.2 Duration of the session

75-120 minutes including questions, discussions and group exercises.

4.3 Resource Persons/Course Trainer for Conducting the Training Sessions

CCHPU and UNICEF capacity building team have reviewed the course curriculum and explored most relevant resource persons from DGHS and other relevant institutions to conduct the sessions. A potential team of facilitators will be formed based on professional and subject related experiences. Additionally, a facilitator for this training course may have practical experience on training facilitation capacity and use of different training methods especially participatory training methods and proper use of training materials and understand the needs and dynamism of participants of the session.

The facilitators may follow some of the following points to conduct the sessions:

- Pay particular attention to the learning objective of the training session
- Prepare and collect materials needed in the training
- Bring difference in demonstrating various examples on the subject/topic
- Practical experiences/evidences would help participants to learn better
- Getting to know the trainees and their expectations from the training;

- Consistent on the topic relevant discussions/facilitations/group working

4.4 Selection of Participants

Participants will be selected mainly from the district and Upazilla level of DG Health Services. However, relevant stakeholders particularly academic, research and non-government organizations can also participate in the training. At the initial stage, this training course curriculum will be in three training events in three coastal districts. It is expected that there will be about 20 health officers/managers in each of the training events. DGHS/CCHPMU may use some basic criteria such as most vulnerable working district/Upazilla, scope of playing vital role during emergency period, gender and so on to select the participants.

4.5 Training venue

A suitable venue where 20 participants can be comfortably accommodated and have adequate space for group works should be selected. It is expected that the venue is well ventilated, having electric line and provision of multimedia media plug connection points, enough light, Ceiling Fan/AC connection and workable seating arrangement. Seats in the classroom should be arranged in a “U” shape so that interactive participation can be ensured and facilitator can have the opportunity to interact and observe the participants easily. Sufficient tables and chairs should be available for the group works and exercises. It will be better to keep provision for accommodation and food for the participants at the same premises of the training venue, as the training is expected to be fully residential.

5. Expected Course outcomes

The participants of this course will use their competence with enhanced knowledge gained from this course in successful planning and implementation of climate resilient health system in the country.

6. Modules of the Training Course

This Training course curriculum is a resource material to support the understanding of climate change impacts on human health which includes various topics like climate change basics, existence of diseases that are directly related to exacerbating under climate conditions and so on. This curriculum consists of seven specific modules that highlight different issues. The modules are intended to support and provide information on various climate conditions that have direct relationship with health and also outlines the global and national policies, understanding and framework which address the issue. The modules are:

6.1 Module 1. Introduction to weather, climate, climate change and variability

Session 1

Introduction to weather, climate change and variability

Learning Objectives of the Session:

After attending the session, the participants will able to:

1. Understand the basic information about climate change, its causes, and consequences
2. Introducing the greenhouse effect and greenhouse gases
3. Gain knowledge on climate change induced hazards and associated impacts at Global and national level (Bangladesh) due to climate change

6.1.1 Concept and basics of weather, climate change, greenhouse effect climate variability

What is weather and climate?

While weather consists of various meteorological events like rain, wind and sunshine and can change every hour, climate is the mean of all the events over a long period of time.

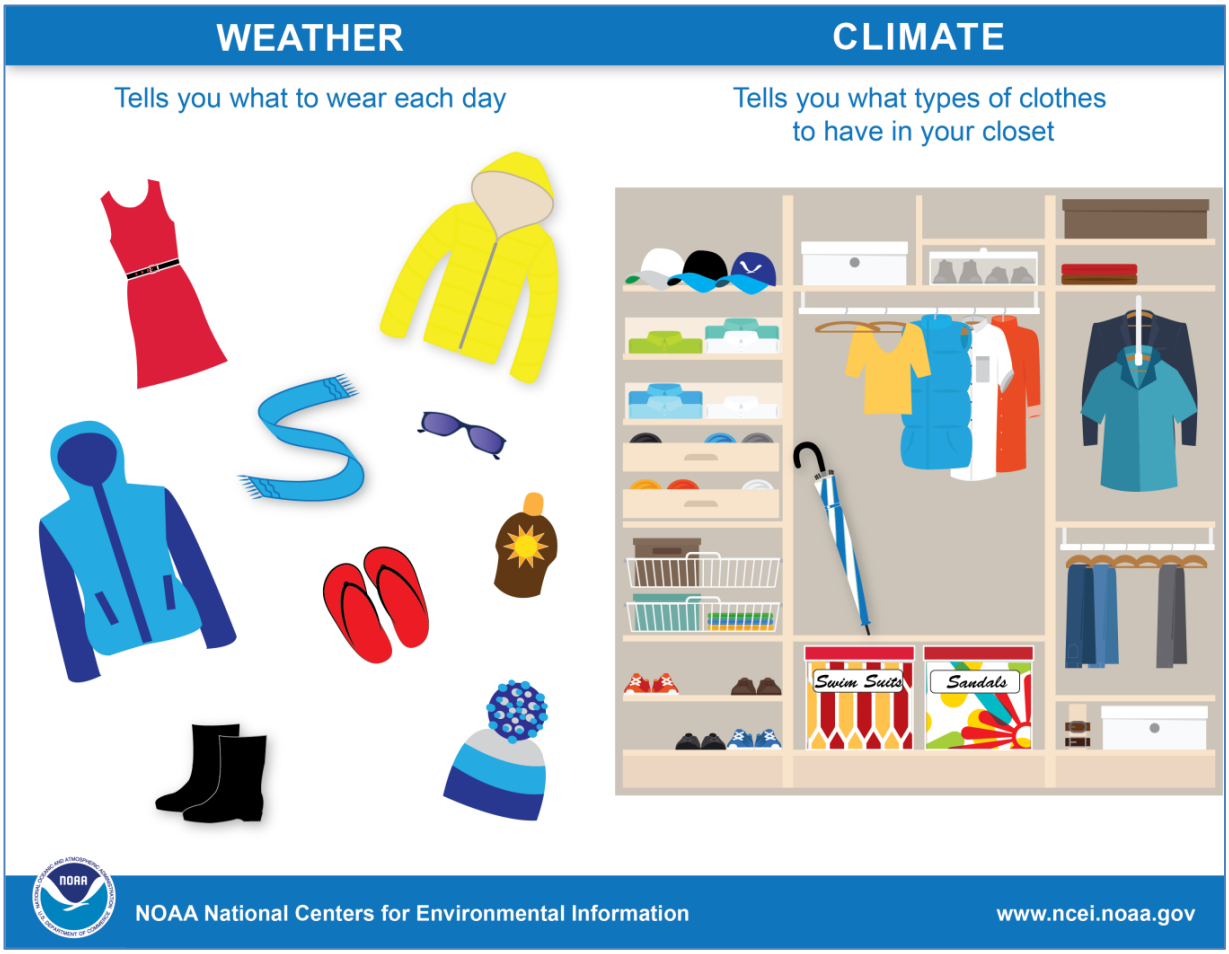

Figure 1. Understanding the difference between weather and climate (NOAA, 2019)

Figure: Understanding the difference between weather and climate (NOAA, 2019)

Weather

The mix of events that happen every day within the atmosphere is called weather. It is different in various parts of the world and weather changes every minute of the day to hours, days, weeks and even months (NOAA, n.d.). Weather refers to changes in the atmosphere, which are mostly short-term. Observers and automated stations measure the conditions of weather every day from various locations. Some of the observations are made every hour whereas some are made daily. Patterns and trends in weather conditions can be seen through systematic weather records. Weather happens very closely to the ground in the layer of the atmosphere, which is called the troposphere. A number of factors change the atmosphere, which includes air pressure, humidity, temperature, wind speed and direction.

Climate

Climate refers to long-term changes in a specific area- various areas have various type of climate. It is the average condition of temperature; precipitation, humidity, wind, and other measures of weather that take place in an area at a particular place- which includes taking average of over 30 years. Various places in the world have varying climate. The term *'global climate'* refers to the planet's

climate as a whole with the average of all the regions. Climate events, which include El Nino, happen over a number of years with bigger changes that happen over decades. The climate change is constantly changing and the Earth too is now changing at an unprecedented rate (NOAA, n.d.).

Climate Variability

Climate Variability defines variations in the mean state and standard deviations, the occurrence of extreme events, etc. of environment on all temporal and spatial scales. It is beyond that of individual weather events. Variability can be due to natural core processes within the climate system. It can be variations in natural or anthropogenic external forcing. While climate change refers to long-term tendency of climatic variables due to global warming, climate variability refers to the natural variation, which is caused by the climatic variables. This variation is due to natural causes like time of the day, season, the presence of thunderstorms, and so on.

Climate Change

The Earth's climate is not static, and has changed many times in response to a variety of natural causes. 'Climate change' refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to internal processes and external forcing. Some external influences, such as changes in solar radiation and volcanism, occur naturally and contribute to the total natural variability of the climate system. Other external changes, such as the change in composition of the atmosphere that began with the industrial revolution, are the result of human activity. (Cruz et al., 2007; Smith et al., 2014).

The Greenhouse effect

The Sun powers Earth's climate, radiating energy at very short wavelengths, predominately in the visible or near-visible (e.g., ultraviolet) part of the spectrum. Roughly one-third of the solar energy that reaches the top of Earth's atmosphere is reflected directly back to space. The remaining two-thirds is absorbed by the surface and, to a lesser extent, by the atmosphere. To balance the absorbed incoming energy, the Earth must, on average, radiate the same amount of energy back to space. Because the Earth is much colder than the Sun, it radiates at much longer wavelengths, primarily in the infrared part of the spectrum. Much of this thermal radiation emitted by the land and ocean is absorbed by the atmosphere, including clouds, and reradiated back to Earth. This is called the greenhouse effect. The glass walls in a greenhouse reduce air-flow and increase the temperature of the air inside. Analogously, but through a different physical process, the Earth's greenhouse effect warms the surface of the planet. Without the natural greenhouse effect, the average temperature at Earth's surface would be below the freezing point of water. Thus, Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and clearing of forests, have greatly intensified the natural greenhouse effect, causing global warming. (Cruz et al., 2007).

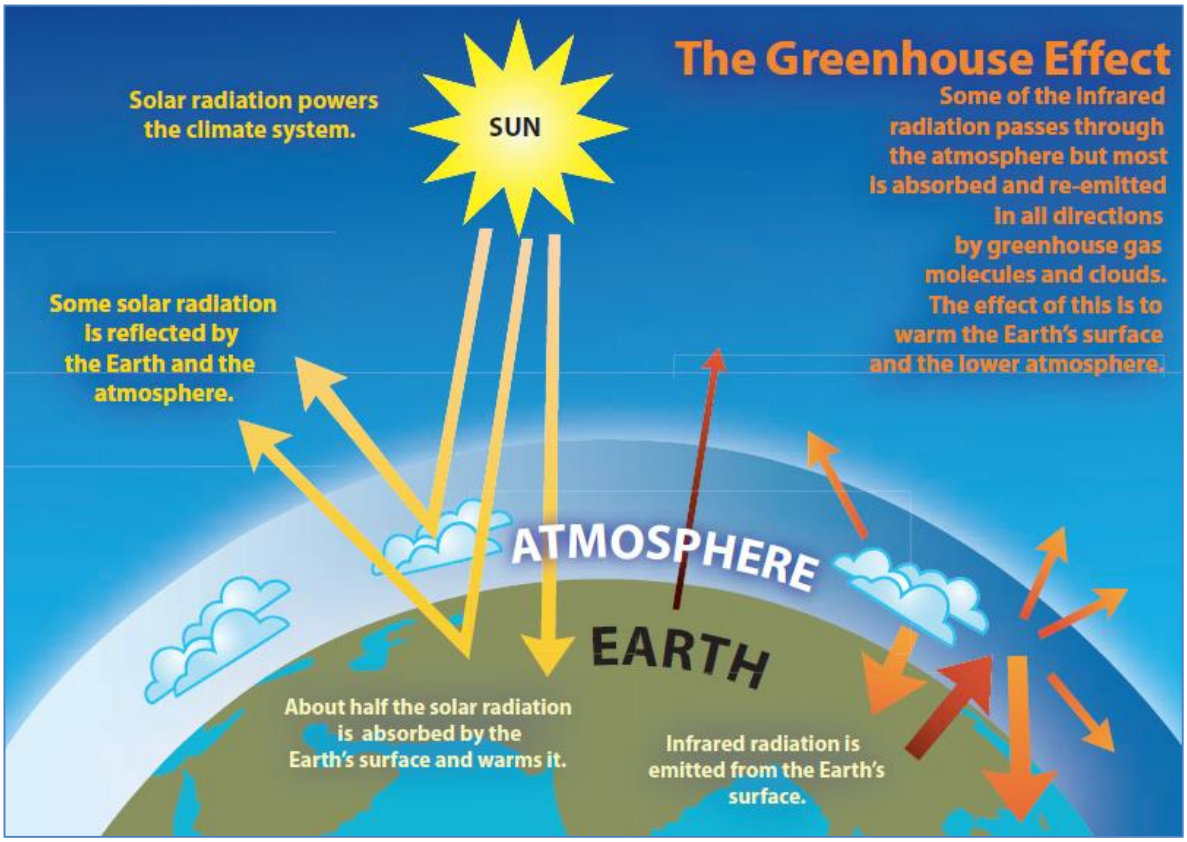

Figure 2. The Greenhouse effect (Cruz et al., 2007; WHO, 2008)

The greenhouse gases and sources:

Name	Description
Water vapor	Is one of the most abundant gases in the atmosphere and builds up with the evaporation from water bodies on Earth.
Carbon dioxide (CO_2)	Is produced by the combustion of fossil fuels and from forest fires.
Methane (CH_4)	Animal husbandry, irrigated agriculture and oil extraction release important amounts of this potent greenhouse gas.
Nitrous oxide (N_2O)	Is a by-product of burning fossil fuels and is also released when ploughing farm soils.
Ozone (O_3)	Main element of the protective layer in the upper atmosphere, which shields the Earth from the sun's harmful ultraviolet radiation. Ozone is both a natural and a man-made gas. Produced in excess as a result of smog and severe air pollution, it becomes harmful to human health.
Chlorofluorocarbons (CFCs)	Chlorine-containing gas used for refrigerators, air conditioners, aerosol spray propellants and cleaning agents. Chlorofluorocarbons cause depletion of the atmospheric ozone layer.

Source: WHO, 2008

The atmospheric concentration of carbon dioxide has been on the rise since 1850s in all regions (Smith et al., 2014). Methane is released mainly from the digestive processes of the cattle and from fermentation activities in the landfills. Nitrous oxide is released for a number of chemical and industrial processes as well as from agriculture. There are similar substances and their affiliated products like chloroflurocarbon (CFCs) and hydrocholorofluorocarbons (HCFCs), which add to these gases. Ozone (0_3) is generated through a number of chemical reactions, which includes nitrogen oxides, carbon monoxide, and volatile organic compounds (VOCs). Urban area is the largest emitter of the GHGs**.**

Heat Island Effect

“Heat islands” mainly refer to urban set up where infrastructure and buildings absorb and then release more solar energy. Therefore, the temperature of the air and surface around increases. This demands the use of air conditioning and hence increases the emissions of greenhouse gases. However, this does not directly contribute to global warming (**WHO, 2008).**

What is happening to the earth’s temperature?

The global temperature is on a rise due a number of activities mostly which are human induced. The large scale contribution of greenhouse gases from the inidstrial countries play a major role in the increase of global temperature. The figure above shows the emission of greenhouse gases from 1870 to 1990 which shows an upward trend and the factors playing a role for such steep growth includes combustion of large scale fossil fuel, deforestation, industrial activities and so forth (WHO, 2008).

6.1.2 Global and national climate change induced hazards

Climate change is a long-term change in an area's temperature and in ordinary weather patterns1 (National Geographic Society 2019). Climate is simply the prevailing or normal weather in a specific region: temperature, precipitation and wind patterns are included in the word ‘climate’. As a consequence of global warming, climate change is happening around the globe. It has become one of the severe problems, thus poverty and inequality cannot be removed without discussing the causes and implications of climate change.

Climate change induced hazards including rising temperature (1.5°C and 2°C), rainfall variation, drought, cyclone and storm surge, sea level rise, salinity intrusion, heat wave, cold wave and other related events are posing serious threat to life and livelihoods of the human being (Cruz, et al., 2007; Smith et al., 2014). The severity of the climate change on water availability, ecosystems, food and agriculture, coastal livelihoods, health is increasingly clear, and any further delay in taking appropriate adaptation actions will intensify the risks.

1 https://www.nationalgeographic.org/encyclopedia/climate-change/

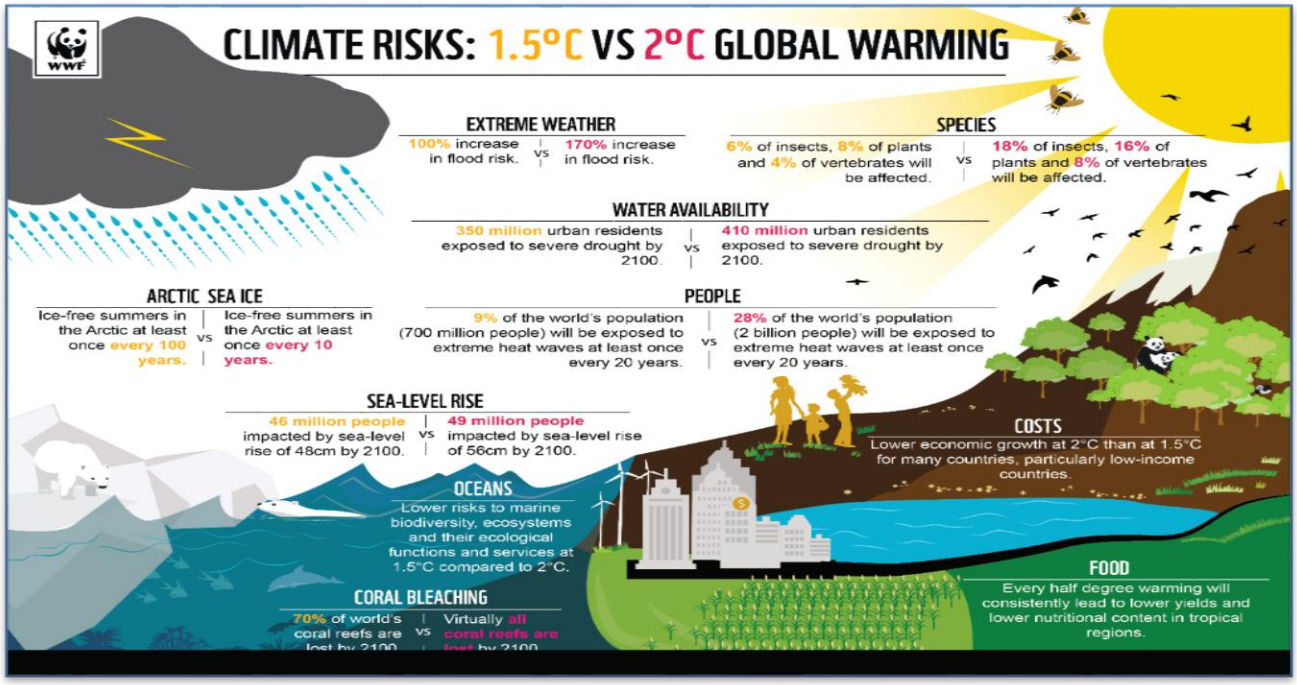

Figure 3. Impacts of 1.5 Degree and 2 Degree (WWF, n.d.)

Bangladesh is one of the nations, which is mostly impacted by disasters in the world. In every year floods, tidal surges, cyclones and river erosion are common and dangerous threats, which are affecting millions of individuals[2] (UNICEF UK 2007). Bangladesh is situated in a low-lying delta between the Himalayas and the Bay of Bengal, created by a thick network of tributaries of the mighty Ganges, the Meghna and the Brahmaputra. The current population of Bangladesh is 168,061,9673, which is equivalent to 2.18% of world population and has a population density of 3,344 people per mi^2 (WorldoMeters 2019). According to the Department of Disaster Management in the Ministry of Disaster Management and Relief, the major disaster risks in Bangladesh are floods, cyclones, droughts, tidal surges, tornadoes, earthquakes, river erosion, fire, infrastructure collapse, high arsenic contents of ground water, water logging, water and soil salinity, epidemic, and various forms of pollution.

6.1.3 Climate change impacts in Bangladesh (Brief)

Bangladesh is a country of highly populated and with limited resources and the country has a good growth of economy. Hazard means an occurrence that has the ability to cause a disaster, which can be either natural (flood, drought, tsunami, cyclone), or human-induced (chemical spill, fire), or biological (SARS, bird flu) or technological (nuclear generator failure) in nature. There are 64 districts in Bangladesh and among them 204 are subjected to the strongest climate change induced hazards

2 UNICEF UK. (2007). *Our Climate, Our Children, Our Responsibility: The implications of climate change for the world's children*

3 https://www.worldometers.info/world-population/bangladesh-population/

such as cyclones, floods, flash floods, drought, etc (MoDMR, 2013). Infant mortality rate is increasing day by day with the increasing impacts of climate change. There are nearly 12 million children who are at increased risk of floods, also 4.5 million children are frequently affected by cyclones in coastal region and An additional 3 million kids live inland, where farming communities are suffering from growing drought (UNICEF, 2019).

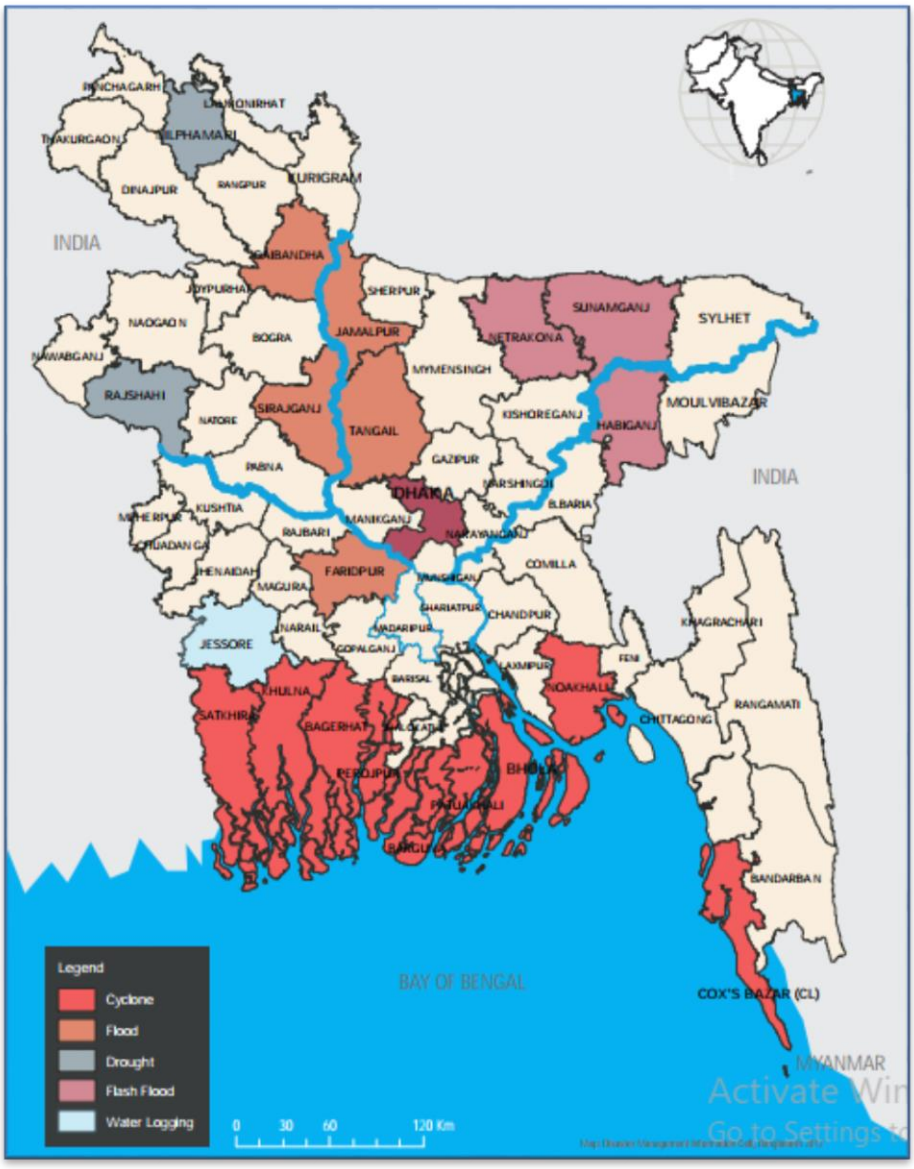

Figure 4. Disaster prone districts of Bangladesh (UNICEF, 2019)

In the map, red marked districts in the lower part of Bangladesh, facing the Bay of Bengal are severely Cyclone affected. Gaibandha, Sirajganj, Jamalpur, Tangail and Netrokona, Sunamganj, Habiganj are affected respectively by floods and flash floods. Drought is mostly occurred in the northern region-Rajsahi, Nilphamari in these districts (MoDMR, 2013).

Disaster-prone Districts		Projected Under-5 Population 2018*	Projected Under-18 Population 2018*
DISTRICT	MAIN RISK		
Bhola	Cyclone	229,660	870,403
Barguna	Cyclone	94,938	365,730
Patuakhali	Cyclone	172,264	674,206
Pirojpur	Cyclone	111,555	452,548
Cox's Bazar	Cyclone	378,154	1,395,360
Noakhali	Cyclone	451,540	1,718,893
Tangail	Flood	386,040	1,482,420
Faridpur	Flood	219,686	862,401
Bagerhat	Cyclone	133,822	551,104
Khulna	Cyclone	200,105	831,287
Jessore	Water Logging	276,411	1,112,531
Satkhira	Cyclone	185,281	772,118
Netrokona	Flash flood	318,463	1,121,414
Jamalpur	Flood	279,345	1,025,598
Sirajganj	Flood	391,315	1,440,772
Rajshahi	Drought	246,764	1,027,032
Gaibandha	Flood	293,269	293,269
Nilphamari	Drought	239,662	888,557
Habiganj	Flash flood	326,517	1,125,993
Sunamganj	Flash flood	424,275	1,408,194
Total number of children at risk:		5,359,067	19,419,829

Figure 5. UNICEF estimates of child population at risks in different districts

From 20 of Bangladesh's 64 districts, there are total 19.4 million children who are at a risk to the most destructive and hazardous consequences of climate change (UNICEF, 2019). In addition, 5 million among them are less than 5 years old (UNICEF, 2019). Every child deserves a better future but this changing climate is diminishing their chances and hopes. They are deprived of the basic necessities, such as fresh water, healthy nutritious food, better living and many more opportunities. Assaduzaman Khan, Assistant Director of Cyclone Preparedness in Kulapara, claims that the nation is on the cutting edge of changing climate (UNICEF, 2019).

Some major climate change induced hazards are described below:

Flood: There are four main types of floods in Bangladesh: flash floods, river floods, rain floods and coastal storm-surge floods. Flash floods generally occur in the eastern and northern rivers, along the borders of Bangladesh. One outcome of enhanced rainfall in the monsoon due to climate change is probable to be flash flooding in the Sylhet and Chittagong as heavy rainfall leads to fast increase and

fall in river levels as it flows rapidly down the mountains (Huq, et al., 1996). From 1974-2004, Bangladesh has suffered from 8 major floods of the scale hydrologists would ordinarily expect to occur only once every 20 years (Ahammed and Baten, 2019).

In 2007, more than half of Bangladesh was seriously affected by monsoon flooding. The floods caused: 1100 deaths (90% of them children), 400,000 displaced people, 1.1 million damaged or destroyed homes, 162000 cases of diarrhea, and 2.2 million acres of damaged cropland. Many farmers lost their crops twice and were unable to replant (UNICEF, 2016).

Flooding increases the risk of diseases by extending the range of vectors as well as by washing agricultural pesticides into drinking water. Floods induced by heavy monsoon rain can contaminate cholera bacteria with drinking water, while cholera bacteria can develop better in droughts in stagnant water in lakes and waterways.

Cyclone: Cyclonic storms also known as typhoons, hurricanes or cyclones, are common along the 700 km coastline of Bangladesh (Tanner, 2005). In present days, serious cyclones happen at a pace of 1.3/year which speeds of up to 275 km/h (Chowdhury, 2002)

Cyclone Sidr struck Bangladesh's low-lying and densely populated shore on the evening of 15 November 2007 (UNICEF, 2014). The Sidr devastated 30 districts in the south across the divisions of Barisal and Khulna. It has took life of 3,363 people, 55,282 people were injured, .5 million people lost their accommodation; 2.5 million acres of crop were greatly damaged (UNICEF, 2016). After Sidr, on 25th May Cyclone Aila hit 14 districts on the south-west coast of Bangladesh (UNICEF, 2014) but people were not till then recovered from the previous attack of cyclone. 190 people lost their life immediately during the attack, 6000 km of roads became destroyed, more than 500000 people lost their home, thousands of schools colleges were damaged (UNICEF, 2016).

Storm Surge: Storm surges are those in which the powerful cyclonic winds push sea water far inland. These are among the highest in the globe and much more hazardous than the real winds produced by the cyclone (Hoq, 1999). Storm surges cause most of the deaths during cyclones as well as destroying peoples' homes and livelihoods; in fact it is the height of the surge rather than the power of the storm that makes a cyclone devastating or not.

Drought: From November to May (Tanner et al., 2007) every year Bangladesh experiences a dry period, when rainfall is normally low and a deficiency between rainfall amount and evaporation rates. Bangladesh normally faces two dry periods. They are – Kharif & Rabi and Pre-Kharif (UNICEF, 2016).

1. *Kharif:* Droughts, which occur from June to October. It damages the moisture holding capacity in soils which affects the production of crops.

2. *Rabi and Pre-Kharif:* Occurs from January to May, due to cumulative effect of dry days and high temperature. It damages all 'rabi' crops, like rice, wheat, potato, pulse etc.

The north-western region of Bangladesh (Rajsahi, Dinajpur, Nilphamari etc.) faces droughts most (MoDMR, 2013). During this time, approximately 2.7 million hectares of soil in Bangladesh are susceptible to annual drought and according to the government, there is a 10% chance that 41-50% of the nation will experience drought in a specified year (Tanner et al., 2007). Droughts cause remarkable effect on health, employment, land degradation and population.

River Erosion: River erosion is a significant problem that affects millions of individuals residing along the vast river network of Bangladesh every year. River bank erosion involves moving channels,

creating different channels during floods, slumping banks owing to undercutting and local disruption scouring induced by obstruction. It is estimated that the Jamuna, the Ganges and the Padma eroded around 1,590 km^2 of floodplains since 1973 and created 1.6 million homeless people (Aktar, 2013). Because of river erosion, 50,000 and 200,000 people are migrated each year (Martin et al., 2013). People who lost their lands due to river erosion lately become slum dwellers in metropolitan cities and towns.

Sea Level Rise: The south-western part of Bangladesh has greatly suffered from salinity and water logging but the sea level rise worsens the situation most (MoDMR, 2013). It has been reported that, every year sea level is increasing another 13 inches (Nunez, 2019). Different natural procedures, such as water flow between oceans, movement of tectonic plates, increasing decreasing of land surfaces contribute in the rising of sea level. As the temperature of the Earth's surface are increasing in a high rate, the oceans are absorbing 80% of this heat. Thus thermal expansion and melting of polar ice caps, glaciers, and ice sheets are happening in West Antarctica and Greenland (Nunez, 2019). These melting water are fallen into the oceans and increased the water level. Bangladesh is anticipated to disappear completely under water by 2080, assuming a sea level increase of 62 cm, taking into consideration 16% of soil in the coastal area (Mohal, 2007). A small increase in sea level causes severe effect in coastal areas, like contamination of water and fertilized soil, river erosion, flooding in low lying areas, destruction of habitats of living organism, damage of crops and many more.

6.2 Module 2. Climate Change and Human Health-Global Perspectives

Session 2

Climate Change and Human Health-Global Perspectives

Learning Objectives of the Session:

After attending the session, the participants will able to:

3. Understand the pathways on how climate change affects human health at the global level

4. Learn on the observations and projections of climate change and its associated impacts on human health

6.2.1 Introduction to climate change and human health

Climate change and health are intertwined and has become a major global issue. A number of climate change related hazards like flood, drought, salinity intrusion and cyclone have both direct and indirect health impacts on humans (WHO, 2008; WHO 2015**).** Climate change causes 2.4% of all cases of diarrhea worldwide and 2% of all cases of malaria. Climate change is associated with the destruction of major ecosystem across the world. **WHO (2018)** clearly states "Climate change undermines the social and environmental determinants of health, including people's access to clean air, safe drinking water, sufficient food and secure shelter". In terms of health implications, the poor, marginalized, women and children are the worst victims of climate change across the world, particularly in Small-island developing States (SIDS) and least developed countries. According to IPCC, climate change induced hazards particularly temperature variation, rainfall pattern, heat wave, cold wave, flood, drought, cyclone and salinity intrusion, sea level rise will directly and indirectly affect the human health across the world (Smith et al., 2014).

Box-1. Health is a major concern in IPCC

Climate change will cause (Smith et al., 2014)-

- ✓ Greater risk of **injury, disease, and death** due to more intense heat waves and fires
- ✓ Increased risk of **under nutrition** resulting from diminished food production in poor regions
- ✓ Consequences for health of **lost work capacity and reduced labor productivity** in vulnerable populations
- ✓ Increased risks of **food- and water-borne diseases** and vector-borne diseases.

6.2.2 Climate change sensitive diseases at the global level

The impact and linkages of climate change and human health have been indicated in many of the assessments and reports of different international organizations/ UN agencies (Smith et al.,, 2014, IPCC, 2018; WHO, 2018).

Direct and Indirect Impacts of Climate Change on Human Health

As mentioned above, climate change directly and indirectly affect the human health. According to WHO (2018), the major rapid and slow onset events that have direct impacts include cyclone and storm surges, drought, flood, heat wave, temperature change and wildfires.

One of the greatest drivers of climate change that has the largest contribution to human health risk is fossil fuel combustion, which is a major contribution to the 7 million deaths that happens due to indoor and outdoor air pollution. However if the mitigation commitments of the Paris Agreement are met, millions of lives can be saved from the various forms of pollution. This would in turn bring about major health benefits too since there is a great synergy between climate change and heath in terms of stemming non-communicable diseases (NCDs). On the other hand, the direct and indirect impacts are often mediated by sets of environmental, social, infrastructural and other factors (Figure 3).

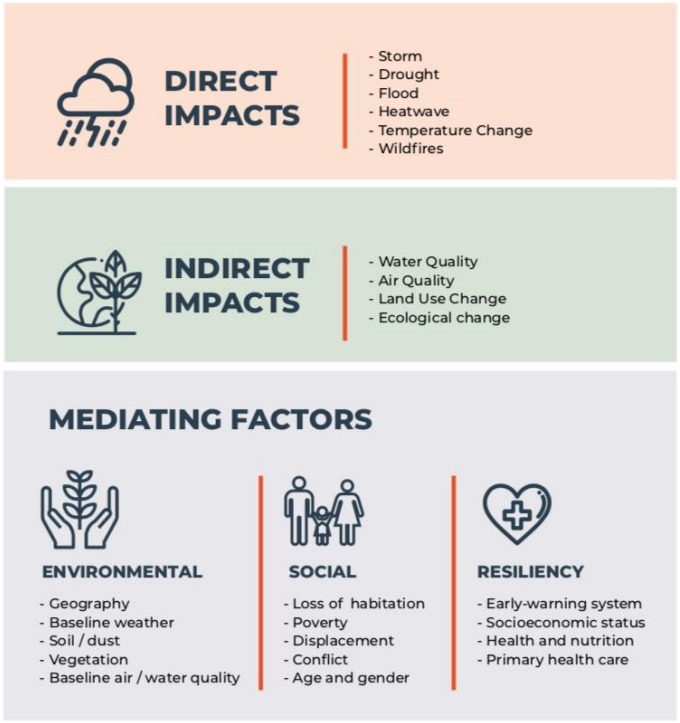

Figure 6. Direct and indirect impacts of climate change on human health

Climate Sensitive Diseases

Vector borne, water borne, food and tick borne diseases, air quality related infections, occupational health disorders, heat and cold wave related health problems and mental disorders have been mostly referred in the Fifth Assessment Report (AR5) of IPCC (Smith et al., 2014). The most recent report of IPCC reiterates that the human health risks will be further increased due to increase of global warming of 1.5°C (IPCC, 2018). The IPCC Fourth Assessment Report clearly mentioned that the climate change influence global burden of diseases and premature deaths (Cruz et al., 2007). Estimation shows that climate change was responsible for about 0.2 % of the global mortality in 2004 (WHO, 2009). WHO (2009) states “Climate change was estimated to be already responsible for 3% of diarrhea, 3% of malaria and 3.8% of dengue fever deaths worldwide in 2004.

It appears that some of the major climatic hazards including rising temperature, extreme weather pattern, rising sea level and increased carbon dioxide primarily change the quality of air, water and

other ecological systems (CDC, 2014). These largely result increase of vector, water borne and air quality related diseases (Figure 4 below).

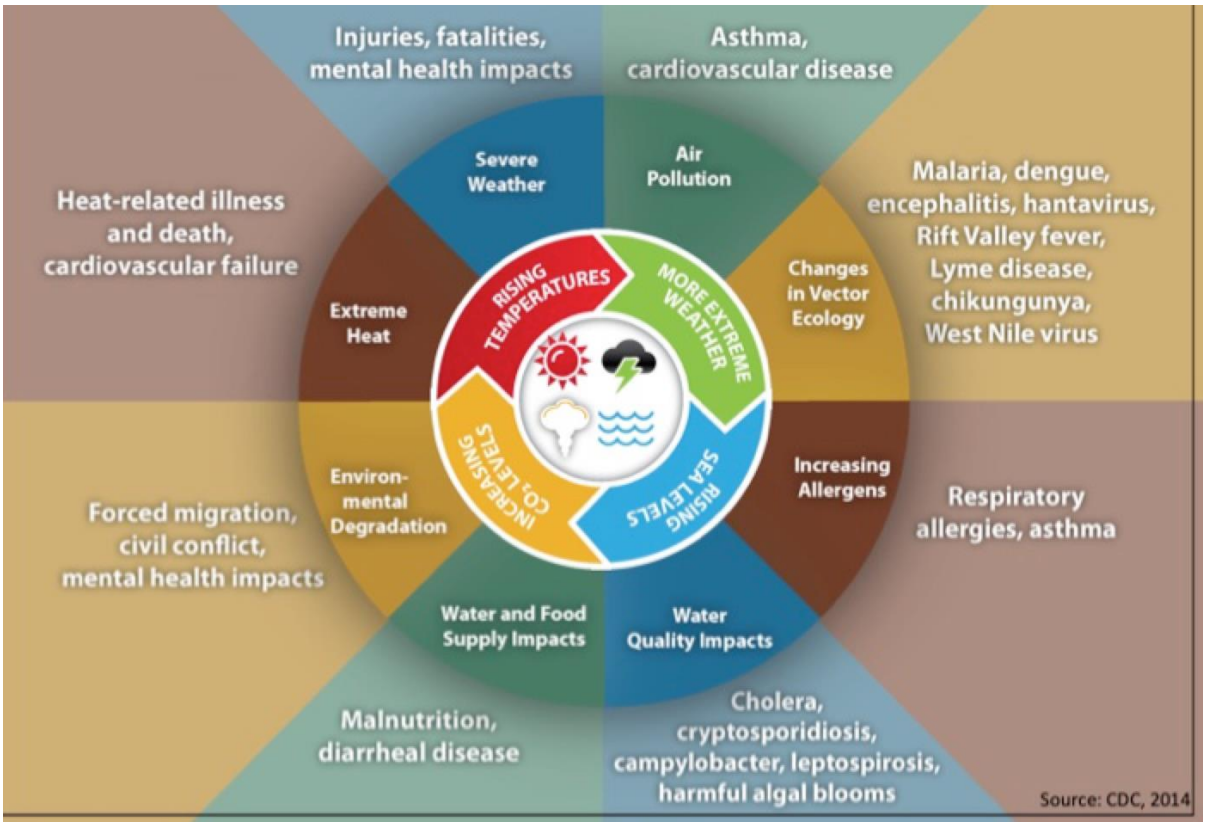

Figure 7. Climate Sensitive Diseases at the global level (CDC, 2014)

According to IPCC (Smith et al., 2014), the incidences of vector borne diseases are alarmingly increased across different regions/countries. The following table shows annual observed incidences of different vector borne diseases and their hotspot regions/countries.

Table.1. Observed climate sensitive vector borne diseases during 2008-2012 in different regions/countries (Smith et AL., 2014)

Type of Diseases	Name of Climate Sensitive Diseases	Hotspot Region/Countries	Observed Cases per year
Mosquito borne diseases	Malaria	Mainly Africa, SE Asia	About 250 million
	Dengue	100 countries especially in Asia and the pacific	About 50 million
Tick borne diseases	Tick-borne encephalitis	Europe, Russia, Mongolia and China	About 10,000
	Lyme	Europe, Asia and North America	About 20000 in USA

Other vector borne diseases	Hemorrhagic fever with renal syndrome	Global	01.5 million to 0.2 million
	Plaque	Global	About 40,000

Case Studies on Climate Sensitive Diseases/health disorders at the global level

The Special Report WHO on Health and Climate Change for CoP24 indicated a number of communicable and non-communicable diseases to be increased due to climate change (WHO, 2018). Figure 5 below indicates about the water borne diseases, cardiovascular disease, and heatstroke, under nutrition, respiratory infections and some other health disorders. The following cases are representative examples of climate related diseases at the global level:

Case Study 1. Dengue fever in Americas Region, Asia, Africa and Australia and the Pacific

1. Incidences of dengue have increased in Asia (Bangladesh, Pakistan, Nepal, Sri Lanka, Maldives, Malaysia, Thailand, Cambodia, Laos, Philippines, Singapore and Vietnam) and America (Brazil, Colombia, Honduras, and Nicaragua). The Pan American Health Organization (PAHO) has reported incidences of dengue fever of about 2 million people in Americas region. About 85 % (1748000 cases) of the total occurrences were in Brazil, as of 3 August 2019 (ECDC, 2019).
2. In Asia, incidences of dengue in 2019 (as of 12 August 2019) have broken all records in the Philippines, Malaysia, Bangladesh, Vietnam, Thailand, Laos and Cambodia. The Philippines Government has already declared a national dengue epidemic for this year, 2019. This Philippines reported incidences of 146 062-dengue cases and 622 deaths as of 20 July. Malaysia has reported 69,700 dengue cases (as of 15 July 2019), compared to 36,000 cases in the same period last year (ECDC, 2019).
3. In Bangladesh, dengue incidences exceeded 50,000 cases (as of 17 August, 2019; Source-The daily Prothom Alo).
4. In Africa, people of Tanzania, Benin, Mauritius and some other small countries are also suffering from dengue fever. Tanzania reported about 7000 cases, as of 4 August 2019. Australia and New Caledonia also reported incidences of dengue this year.

Case study 2: Heat waves related health disorders

1. It appears that about 125 million people are currently exposed to heat waves in different parts of the world. This heat wave killed more than 70,000 people in Europe in 2003.
2. In the last week of July 2019, heat wave killed 2964 people in Netherlands. https://www.firstpost.com/world/europe-heat-wave-400-more-people-died-in-netherlands-during-record-breaking-summer-week-says-dutch-statistics-agency-7139521.html
3. In 2018, heat wave killed 700 people in Sweden and more than 250 in Denmark. In 2010, 56,000 people died in Russia because of heat wave (Stephen Leahy, National Geography, 28 June 2019
4. https://www.nationalgeographic.com/environment/2019/06/europe-has-had-five-500-year-

summers-in-15-years/)

Case study 3: Flooding

1. In July 2019, over 3 millions of people have been affected by flood in Bangladesh. About 11500 people suffered from diarrheal and other water borne diseases. The total death toll was 101, between 10 and 25 July 2019 (https://bdnews24.com/bangladesh/2019/07/25/death-toll-from-floods-in-bangladesh-crosses-100-in-two-weeks). Diarrhea and cholera outbreaks were also reported in Mozambique and West Bengal of India due to flood in 2000 and 1998 respectively. (https://www.who.int/hac/techguidance/ems/flood_cds/en/)

1. In 2010, 15 million people were affected by flood in Pakistan. At least 6 million people needed urgent medical health services.

2. In 2004, flooding led malaria outbreaks in Dominican Republic (WHO, 2019).
3. During 1996-1997, people of Romania had to suffer from West Nile fever outbreaks, which was resurged in Europe after heavy rain and flooding.

Case study 4: Drought and health problems

1. In 2019, about 43 % of India was suffering from drought. More than 20,000 villages had experienced water crisis without having any water in 35 dams (The Guardians, 12 June 2019). https://www.theguardian.com/world/2019/jun/12/indian-villages-lie-empty-as-drought-forces-thousands-to-flee

2. In 2017, Northern China suffered from the worst drought on record. This Drought affected 2.67 million hectares of productive agricultural land. About 120,000 people and 500,000 livestock experienced drinking water crisis during this drought.

1. About 0.5 million Namibians are suffering from food insecurity caused by drought (lack of rainfall) https://www.bbc.com/news/48185946 (07 May 2019)

2. Drought is causing famines in Ethiopia since 1980s resulting child under nutrition (WHO, 2018).

Figure 8. Climate Sensitive diseases (WHO, 2018)

How Climate Change Affects Human Health: Pathways and Mechanism

The Figure 6 shows that climate change affects human health through three following basic pathways through which climate change is affecting human health (Smith et al., 2014-Figure 6):

1. Direct impacts, which mainly relate to heat, cyclonic events, storm surges, and floods

2. Indirect impacts mediated through natural systems, for example, disease vectors, water-borne diseases, and air pollution

3. Effects heavily mediated by human systems, for example, occupational impacts, under nutrition, and mental stress

The negative impacts of climate change undermine the 'right to health', which has been cited in many reports (WHO, 2018; Smith et al., 2014) and the Paris Agreement. It also undermines the various social and environmental health indicators, which affects the poorest and most vulnerable communities such as small-island developing states (SIDS) and also the least developed countries. Hence it widens the disparity, which exists in the health sector.

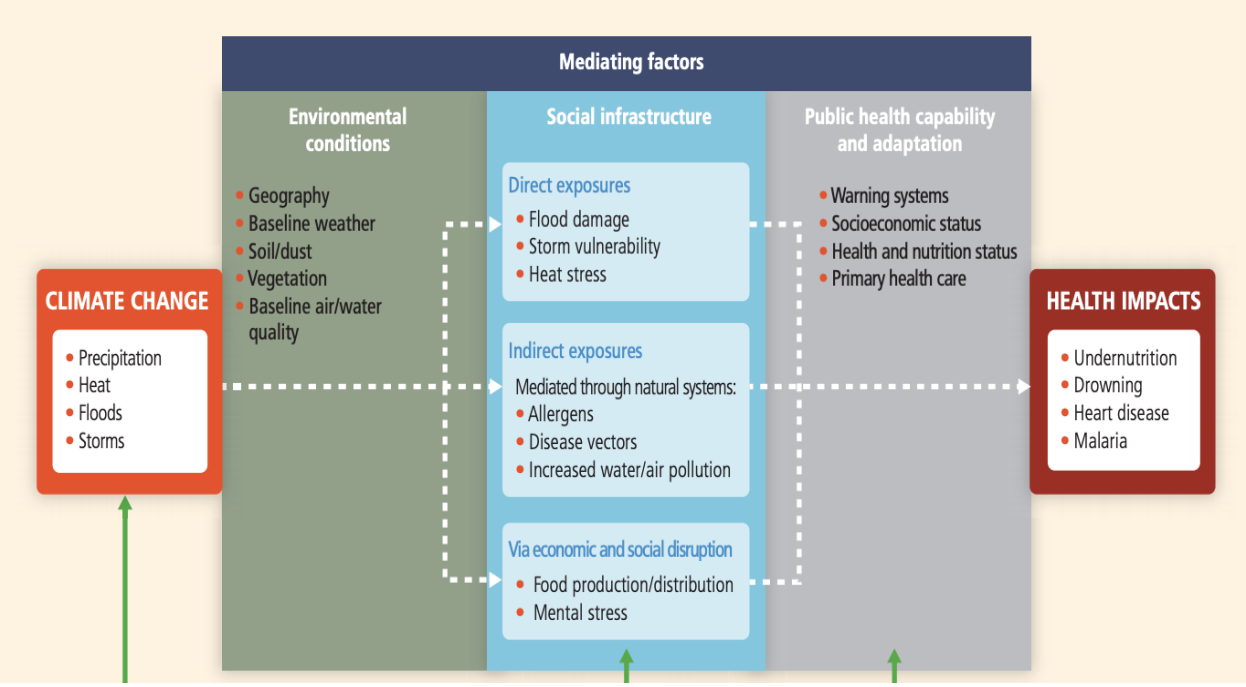

Figure 9. Conceptual diagram showing three primary exposure pathways by which climate change affects health (IPCC, 2014)

The figure 7 below portrays that climate change occurs due to natural causes as well as anthropogenic reasons. Excessive growth in population and unsustainable economic development has proved to be playing a significant role in increase of the greenhouse gas (GHG) emissions, which has

ultimately resulted in intense and vigorous climate change. Extreme weather changes are the major effects of climate change, which not only limits within the respective emission regions but also spreads globally. Besides heat waves, rise in temperature; climate change also influences precipitation.

The changes in weather enhance the microbial contamination pathways, influences the disease transmission dynamics, agricultural ecosystems, hydrology and also risks socioeconomic demographics. The human health, which is our major concern, is affected drastically due to the mentioned influences of climate change. Among the health effects there are temperature related illness and death, extreme weather-related health issues, air pollution related illness, water and food borne diseases, vector-borne and rodent-borne diseases is shown in the figure. It also shows that climate change can be the cause for food and water shortages and also enhance mental, nutritional and infectious effects.

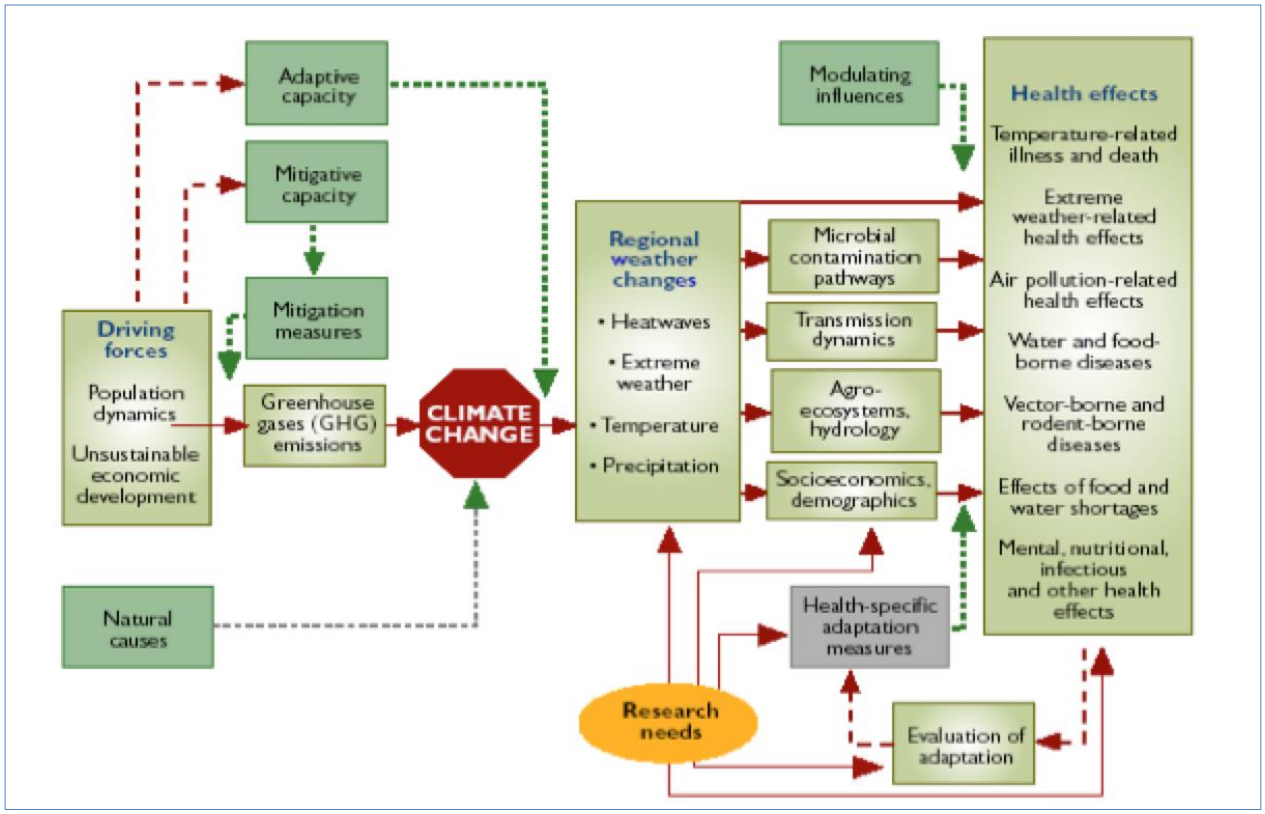

Figure 10. Pathways of climate change impacts on human health (WHO, 2003 and WHO n.d)

6.3 Module 3. Climate Change and Human Health in Bangladesh

Session 3

Climate Change and Human Health in Bangladesh

Learning Objectives of the Session:

After attending the session, the participants will able to:

4. Understand different types of climate sensitive diseases and their state and trend in Bangladesh
5. Gain knowledge on water related health disorders due to climate change
6. Learn on vector borne diseases due to climate change in Bangladesh
7. Provide an understanding on climate change and air quality related diseases/health problems

6.3.1 Introduction to climate change and human health in Bangladesh

Whatever happens to climate and subsequently to various other sectors, all these are important for the main reason that these ultimately affect the health of the people. Climate change is expected to have major impacts on agriculture, water, infrastructure, housing, industry, and health in Bangladesh. In fact, temperature rise, erratic behavior of rainfall, cyclone and storm surge, salinity intrusion, flood, drought are already increasingly affecting the health of the people particularly in the coastal zone. It shows that many diseases are highly sensitive to changing temperatures and rainfall. These include common vector-borne diseases such as malaria and dengue.

6.3.2 Climate sensitive diseases burdens in Bangladesh

The following table 3 sums up the projection results of three childhood diseases and their health burden by 2050 (World Bank, 2014). With an increase in average temperature of 2°C and a 10% increase in the probability of flooding across regions in Bangladesh, the incidence of Acute Respiratory Infection (ARI) is projected to increase by almost two folds, and the incidence of fever is projected to increase by 10%. On the other hand, the incidence of diarrhea is projected to decrease by a mere insignificant 2%. Based on the United Nations population projections for Bangladesh for 2050, the future health burden of these three childhood illnesses is estimated to be about 14 million disability-adjusted life years (DALY). This burden is to account for about 3.4 percent of GDP by 2050.

Table 3: Projected Health Burden by 2050 (World Bank, 2014)

Indicator	Estimation from DHS Data	Projection

	2004	2007	2050
Climate variable			
Average temperature (survey months)	23.5	27.8	29·0
Probability of flooding (%)	22.6	30.6	40.0
Disease incidence			
ARI			
Incidence (%)	18.7	12.3	23.0
Cases (thousands)	9,009	5,734	14,220
Diarrhea			
Incidence (%)	7	9.2	7.3
Cases (thousands)	3,376	4,296	4,529
Fever			
Incidence (%)	39.2	36.1	46.3
Cases (thousands)	18,916	16,787	28,605
Population ages 0-14 (thousands)	48,222	46,541	61,833

Note: The average temperature refers to the survey months. Flooding is defined as monthly rainfall above one standard deviation for a particular location and month.

6.3.3 Climate Change Impacts on Human Health in Bangladesh

Climate change already contributes to the global burden of disease, and this contribution is expected to grow in the future in this country. The following table provides details of climate change related hazards, projected changes and associated health impacts in Bangladesh.

Table 2. Climate change hazards and their impacts on human health in Bangladesh (WHO, IEDCR, 2018-Bangladesh-HNAP (Draft)

Climate change characteristics	**Projected changes**	**Impacts on Health**
Increasing air and sea-surface temperatures	Average air temperatures are expected to increase by up to 1.4ºC by 2050 and by 4.8ºC by 2100, depending on future greenhouse gas emissions scenarios (WHO, 2015).	Reduced agriculture and fisheries production leading to increased food insecurity and food safety issues. Increased risk of heat-related illnesses.
Altered rainfall patterns	Most models predict drier dry seasons and wetter wet seasons for Bangladesh, as well as more “extreme/high” rainfall events (WHO, 2015).	Increased risk of drought and flooding leading to negative effects on agriculture production and under-nutrition. Increased risk of vector-borne disease (malaria, dengue, kala-azar, and chikungunya) and water borne diseases, notably diarrheal disease

More severe extreme weather events	Tropical cyclones are expected to decrease in frequency but increase in intensity. 20.3 million people are projected to live in cyclone high-risk areas by 2050 compared to 8.3 million in 2015 (WHO, 2015).	Destruction of farming lands and health facilities. Injuries and death from extreme weather events. Mental health issues due to climate-related population displacement and effects on livelihoods
Sea-level rise	Current saline intrusion reaches 100km from the Bay of Bengal. 7.2 million people are projected to be affected by flooding due to sea-level rise every year between 2070-2100 under a high emissions scenario (WHO, 2015).	For low-lying coastal communities sea-level rise can cause crop failure, saline intrusion into drinking water supplies, erosion and possibly even the need for relocation.
Ocean acidification	The increasing acidity of sea-water has a detrimental impact on ecosystems and reduced biodiversity (WHO, 2015).	Destruction of ecosystems and reduced biodiversity can have negative impacts on fishing industries and lead to increased food insecurity.
Air pollution	Many drivers of climate change also contribute to air pollution. Outdoor air pollution data for 5 cities in Bangladesh have PM2.5 levels greater than WHO guidelines. Household air pollution is also high in rural communities (WHO, 2015).	Increased morbidity and mortality from respiratory infections, lung cancer, and cardiovascular disease.

Key Observations and projections on climate change impacts on human health in Bangladesh (WHO, 2018; WHO, 2015; UNICEF, 2016; Kabir et al., 2016)

- ✓ Studies indicate that climate change have potential health risks in Bangladesh (Kabir et al., 2016 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4821870/;
- ✓ Most climate sensitive diseases in Bangladesh include Diarrhea, Malaria, dengue, Kalazaar. In addition, heat stroke, cardiovascular disease, respiratory disease, allergies also affect many people especially in the urban areas. Emerging diseases include Chikungunya, Japanese encephalitis, zika virus and so on.
- ✓ Dengue incidences have broken all earlier records in2019 (Please see table 4 below). Dengue outbreak attacked all 64 district of the country during July-August 2019.
- ✓ On an average 7.2 million people will be affected by sea level rise between 2070 and 2100 if there is no adaptation investment.
- ✓ About 117 million people are projected to be at risk of malaria incidences by 2070

- ✓ Heat related deaths will be increased to 30 per 100,000 by 2080 for elderly people under high emission scenario.
- ✓ Prevalence of child under nutrition in children under age 5 is 31.9% (2013).
- ✓ Women and children are the worst victims of the household air pollution. Consequently, household air pollution is responsible for a larger proportion of the total number of deaths from ischaemic heart disease, stroke, lung cancer and COPD in women compared to men

6.3.4 Climate change and water borne diseases

Bangladesh is quite vulnerable to outbreaks of different infectious diseases, waterborne and other types of diseases. **Diarrhea** is the main water borne disease in Bangladesh since long. This is a common disease in the country. It has led to serious public health challenges to control diseases that are infectious in nature. Childhood diarrhea has risks periods among other forms. (Azage et al., 2017). The disease can begin from gastrointestinal infections, which can be due to the ingestion of bacteria, viruses and protozoa. In Bangladesh there are frequent incidents of flood and excessive rainfall which impedes regular livelihoods of the poor, especially who reside in the rural areas. This way, the microorganisms are transmitted from person to person via the fecal route and as well as the oral route. An infected personal therefore suffer from loss of excessive body fluids (IAMAT, n.d.). According to the Daily Star (2017), 45000 children die due to this disease every year, which is extremely alarming. Water contamination and lack of safe and proper water, sanitation and hygiene facilities only exacerbate the situation. However, according to The Economist (2018), Bangladesh has shown significant improvement in reducing the onsets of diarrhea as shown in the figure below.

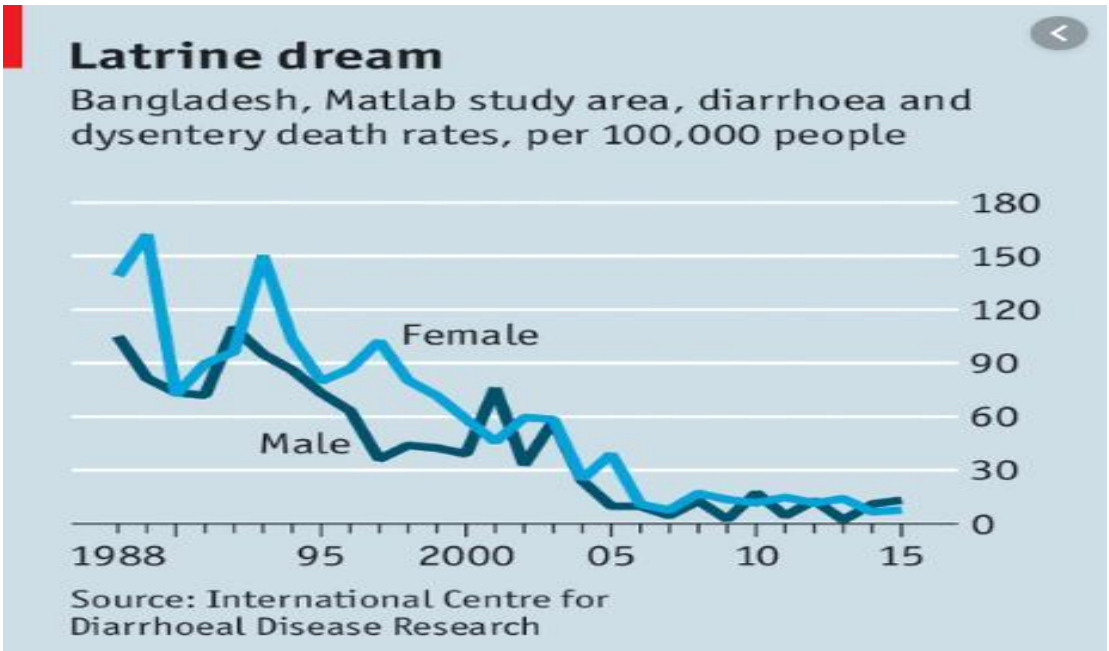

Figure 11. Statistical review showing the deaths per 100,000 people from 1988 to 2015 (The Economist, 2018)

Record shows that the incidences of diarrhea in Bangladesh are still quite high. Records also show that the incidences of diarrhea in 2016 were much higher than the average incidences of last seventeen years. It has been predicted that the combination of higher temperatures and potential increase in summer precipitation may cause the spread of many infectious diseases (MoEFCC, 2005). Climate change also brings about additional stresses like dehydration, malnutrition and heat-related morbidity especially among children and the elderly.

Box-2. Trend of diarrheal diseases in Bangladesh (DG Health, 2015-17)

Year	Diarrhea	
	Cases (thousands)	Deaths
2000	1,556	475
2001	1,866	521
2002	2,599	1,022
2003	2,287	1,282
2004	2,246	1,170
2005	2,152	929
2006	1,962	239
2007	2,335	537
2008	2,295	393
2009	2,619	360
2010	2,427	345
2011	2,268	70
2012	2631	43
2013	2,641	13
2014	2653	24
2015	2560	24
2016	2409	5

These problems are thought to be closely interlinked with water supply, sanitation and food production. Climate change has already been linked to land degradation, freshwater decline, biodiversity loss and ecosystem decline, and stratospheric ozone depletion. Changes in the above factors may have a direct or indirect impact on human health as well. In addition, cholera, typhoid and other parasitic diarrheal diseases are also occurring in the country.

6.3.5 Climate change and vector borne diseases

Changes in climate are also contributing increasing trend of vector borne disease in Bangladesh. Dengue is now the world's most critical vector-borne disease. Many studies have stated correlation between spatial, temporal or spatiotemporal patterns of dengue fever and climate parameters (Hales et al., 1999; Corwin et al., 2001; Gagnon et al., 2001; Cazelles et al., 2005). The reports also state that approximately one third of the world's population lives in regions where the climate is suitable for dengue transmission.

In Bangladesh, **dengue** was quite unfamiliar disease in the country till its first outbreak in 2000. It started in three major cities (Dhaka, Chittagong and Khulna) with the highest occurrence being in the Dhaka city. People in all ages and both male and female are susceptible to dengue fever. The infection can lead to the fatal dengue shock syndrome (DSS) and dengue hemorrhagic fever. Aedes mosquito transmits this deadly virus to the human being. Aedes aegypti and Aedes albopictus mosquitoes lay eggs in any places but it needs clean water to be hatched. Usually dengue transmission occurs during June-September of the year.

At present, Dengue fever is the most dangerous epidemic in Bangladesh that has been termed 'particularly alarming' given the state of health care in Bangladesh. Experts have mentioned that

climate change may be a vital reason for the prevalence of the dengue disease in Bangladesh. The warmer and humid conditions along with irregular rainfalls help the Aedes mosquitoes to breed. Dhaka capital is a perfect breeding ground for the mosquito breed. The weather and environmental condition where humidity and temperature has a favorable combination causes other vector-borne diseases to be bred too. According to reports, warming in temperature causes the eggs to mature to adult mosquitoes faster. Hence, climatic condition plays a critical role in the breeding of these mosquitoes.

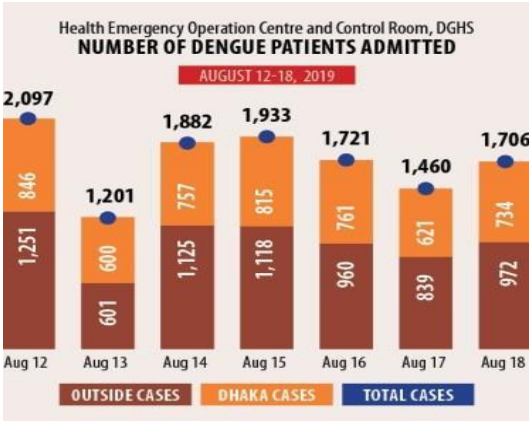

Figure 12. Incidences of Dengue fever during 12-18 August in Bangladesh (The daily Star, 2019)

The Table 4 below shows the trend of three major vector borne diseases in the country. It appears that the dengue fever is becoming serious threat to the people of entire country.

Table 4: Major Climate Sensitive Vector Borne Diseases in Bangladesh: Number of Cases and Deaths, by year (2000-2017)

Year	Malaria		Dengue		Kala-azar	
	Cases	Deaths	Cases	Deaths	Cases	Death
2000	54,223	478	5,551	93	7,940	24
2001	54,216	490	2,430	44	4,283	6
2002	62,269	588	6,132	58	8,110	36
2003	54,654	577	486	10	6,113	27
2004	58,894	535	3,934	13	5,920	3
2005	48,121	501	1,048	4	6,892	16
2006	32,857	307	2,200	11	9,379	23
2007	59,857	228	466	0	4,932	17
2008	84,690	154	1,153	0	4,824	17
2009	63,873	47	474	0	4,301	14
2010	55,873	37	409	0	2,810	-
2011	51,773	36	1,362	6	2,534	2
2012	29,518	11	671	1	2060	-
2013	26,891	15	1,749	2	1428	2
2014	57480	45	375	0	-	-
2015	39719	9	3162	6	-	-

2016	27737	17	6060	14	459	5
2017	29247	13	2769	8	-	-

Source: The Health Bulletin, DGHS, 2014-2018; World Bank, 2014; * as of 17 August, The Daily Star.

Malaria is another critical vector borne disease that affects people of Bangladesh. Malaria is a parasitic infection, which is transmitted by the female Anopheles mosquito, which impacts on humans and insects alternatively. It is one of the most alarming public health concerns in Bangladesh, in addition to another 90 countries across the globe (ICDDRB, 2009). The disease has been affecting 300 million people and has brought about 1 million deaths per year. Bangladesh has 34 Anopheles mosquito species (ICDDRB, 2009).

According to the World Health Organization (WHO), Malaria is one of the biggest challenges to be tackled when compounded with the impacts of climate change where temperature variation plays a role in sustaining the eggs of the mosquito. The disease was nearly eradicating in the 1970s but it has re-emerged of late. In Bangladesh, 13 districts belong to high risk of malaria zone, which touches east and northeastern borders facing Assam, Tripura and Meghalaya. (ICDDRB, 2009)

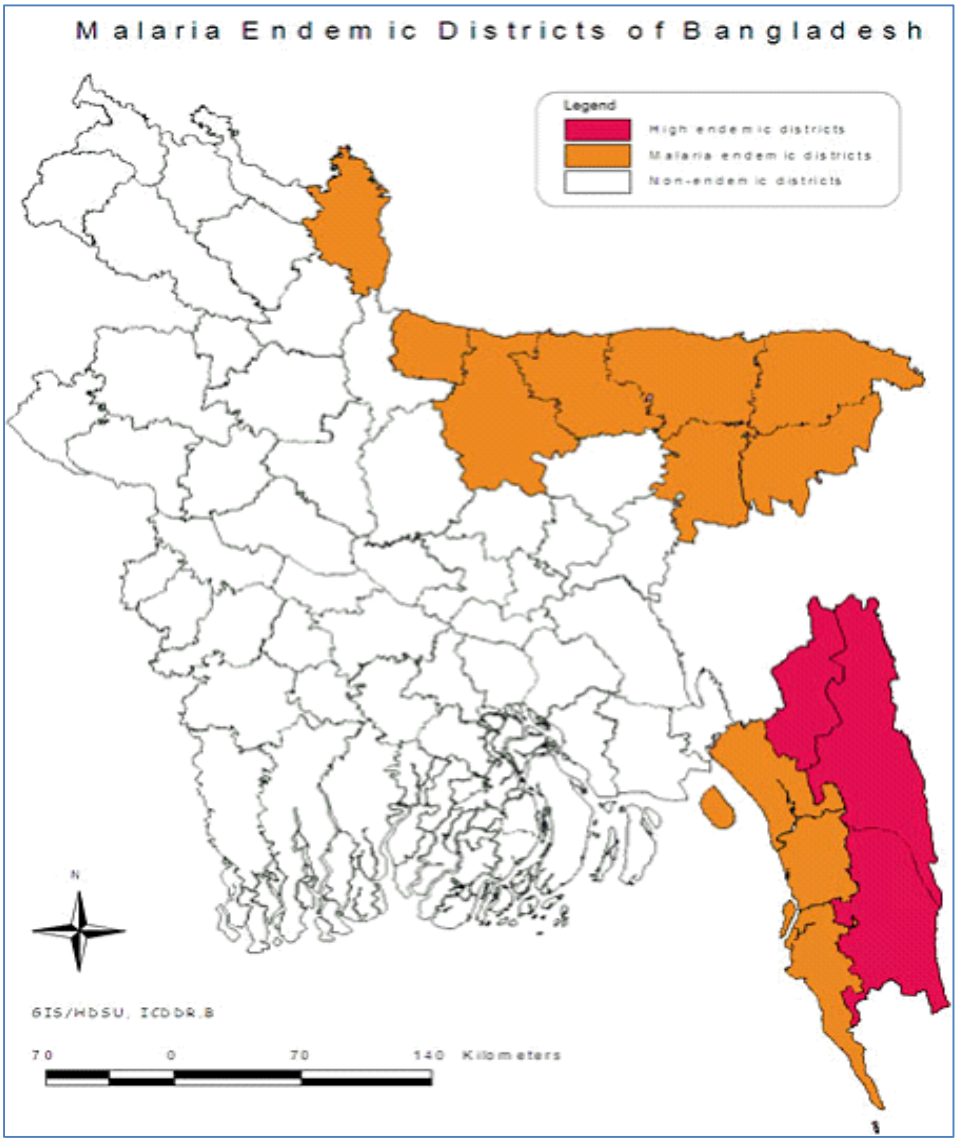

Figure 13. Malaria epidemic districts in Bangladesh
(ICDDRB, 2009)

6.3.6 Climate change and food borne diseases

Climate Change induced hazards, including cyclonic events, variations in temperature and rainfall, drought and salinity intrusion in water resources and soil are adversely affecting the agricultural production and food security in Bangladesh. Much more alarmingly, it is expected that Sea Level Rise will further deteriorate the agriculture sector in future. The fall of rice production in the coastal zones already indicates a disturbing situation under the already changing climatic elements. Planetizen (2008) states, “by 2025 this country is on course to lose 17 % of its land and 30 % of its food production and as a result poverty will increase”. Overall, climate change induced hazards are likely to

increase the agricultural production, thus escalating the risk of malnutrition problems in the country. Smith et al., (2014), states "Cholera may be transmitted by drinking water or by environmental exposure in seawater and seafood".

Box-3. Malnutrition in Bangladesh (Extracted from ICDDRB, 2019)

1. Severe acute malnutrition affects 450,000 children, while close to 2 million children have moderate acute malnutrition.
2. Anaemia affects 52% of children under five years of age.
3. 41% of children under five years of age are stunted.
4. 16% of children under five years of age are wasted.
5. 36% of children under five years of age are underweight.
6. A quarter of women are underweight and around 15% have short stature, which increases the risk of difficult childbirth and low-birth-weight infants.
7. Half of all women suffer from anemia, mostly nutritional in origin.
8. Malnutrition is estimated to cost Bangladesh more than US$1bn every year in lost productivity.

Key Observations and projections on climate change impacts on agriculture and food security in Bangladesh

- According to agricultural statistics, it shows that the rice production at the national level had increased from 27 Million tons in 2007 to over 33 Million tons in 2011, while it increased only 7 Million tons to 8 Million tons in the coastal zone in the respective years (BBS, 2008; BBS, 2010; BBS, 2012).

- Cyclone Sidr in 2007 affected about 2.1 million ha of agricultural and approximately 1.2 million tons of rice were damaged (World Bank 2007)

- Drought affected 25 %–30 % crop reduction in the northern part of Bangladesh (Rahman et al. 2008).

- Nearly 45 % of the agricultural production was reduced due to 1988 flood in Bangladesh (Karim et al. 1996)

- World Bank (2009) projects that the rice production may decline under any Climate Change Scenarios in the country. Annual growth rate is expected to reduce from 2.71 % to 2.55 % under average Climate Scenario during the period of 2005–2050.

- Sea level rise of 50 cm by 2030 may cause 11 % loss of total landmass, which would inundate 215,000– 395,000 ha agricultural productive land of Bangladesh (Habiba et al., 2015)

- Child (<5 years) malnutrition is quite high (31.9 %) in Bangladesh (WHO, 2015)

6.3.7 Climate change and air quality related diseases

Number of changes, which includes atmosphere and climate, have an effect on the biosphere and human environment. The condition is particularly exacerbated by anthropogenic factors, which worsens the condition of global warming. There is a linkage of climate change on respiratory allergy and this area is still lacking research. Environmental factors like meteorological variables, airborne allergens, air pollution have an impact on respiratory diseases as indicates in the following figure.

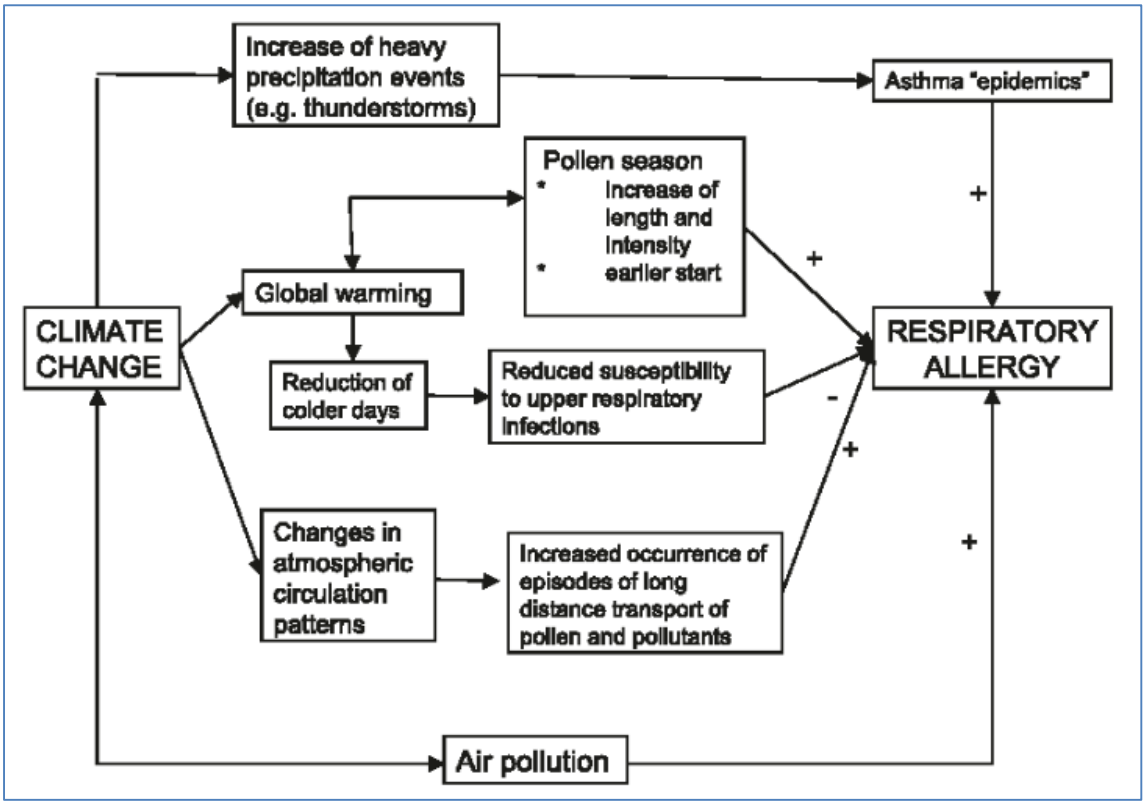

Figure 14. Relationship between climate change and air quality related diseases (D'Amato et al., 2015)

Key Observations and projections on climate change and air quality related health problems

- The Figure 13 indicates the percentage of total deaths from different diseases attributable to household air pollution, 2012 (WHO, 2012).
- The Working Group I (WGI) of the IPCC Fifth Assessment Report (AR5) that climate change will affect potential air quality. If this happens, human health will be affected (Bell et al., 2007; Dong et al., 2011; Chang et al., 2012; Lepeule et al., 2012; Meister et al., 2012; West et al., 2013).
- Climate change will exacerbate the consequences of air pollution by changing atmospheric states and increasing forest fires.
- Globally, air pollution kills about 7 million people every year (WHO, n.d). This report also indicates that about 4.3 million deaths are caused by household air pollution.

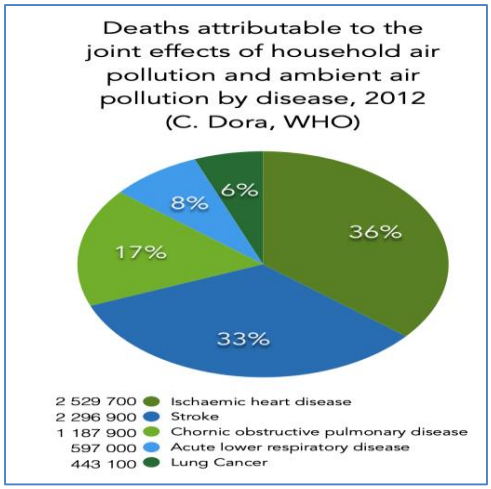

Figure 15. Deaths attributable to household air pollution (WHO, 2012)

- In Bangladesh, acute lower respiratory infections instigated by household air pollution kills about 61 % of the total 17100 children (WHO, 2012).

- It indicates that about 44 % of the total deaths due to ischaemic heart disease, stroke, lung cancer, chronic obstructive pulmonary disease (18 years +) and acute lower respiratory infections (under 5 years) can be attributed to household air pollution (WHO, 2012).

6.4 Module 4. Climate Change and health: Current responses at the global level

Session 4

Climate Change and Health: Current Responses at the global level

Learning Objectives of the Session:

After attending the session, the participants will able to:

8. Understand about the most recent global policy/strategy related to climate change and human health

9. Provide a brief understanding on global decisions and guidance on climate change and health

10. Gain knowledge on global adaptation strategies to reduce impacts on human health

6.4.1 Key Policy/Strategy that address climate change and health at the global level

This session will highlight the global policy and strategic documents that address climate change and health at the global level. Some of the key global policy and strategies include:

United Nations Framework Convention on Climate Change (UNFCCC), 1992

The United Nations family is within the forefront of the hassle to save lots of our planet. In 1992, its "Earth Summit" made the United Nations Framework Convention on Climate Change (UNFCCC) as a primary step in addressing the climate change downside. Today, it's near-universal membership. The 197 countries that have sanctioned the Convention are Parties to the Convention. The final aim of the Convention is to stop "dangerous" human interference with the climate system.

Health issues in UNFCCC Framework

- Health is a key element in UNFCCC articles 1 & 4.1.f
- "Right to health" is a vital human right issue in the preamble of the Paris Agreement (PA)
- Health is a crucial element in the IPCC Special Report on 1.5°C. "The greater the warming, the greater the risks for human health" (WHO, 2018).

- Inclusion of health in NDCs and National Communication (NCs). At least half of the submitted NDCs mentioned about adaptation actions in NDC.
- Health issue is integrated in the work plan of Warsaw International Mechanism (WIM) on loss and damage
- Climate Finance support UNFCCC to address climate change impacts on human health. GEF already supported a number of projects to reduce impacts of climate change on human health

The Paris Agreement, 2015

The Paris Agreement has been one of the strongest public health agreements in the history of this century. Signed at COP21 in 2015, the agreement specifies "Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on the right to health……" and recognizes the central role of "……mitigation actions and their co-benefits for adaptation, health and sustainable development" in enhanced action before 2020 (UNFCCC, 2015). It is the first climate agreement, which has been able to gain the strongest global support. This Paris Agreement has been ratified by 187 countries (UNFCCC, 2019).

The Agreement sets the goal to global temperature to be kept well below 2°C and to take actions to minimize the warming to less than 1.5 °C above the pre-industrial levels. The Low and Middle Income Countries (LMICs) are supported by several funding mechanisms, with a commitment to mobilize US Dollars 100 billion in climate funding annually by 2020 (UNFCCC, 2015). Its objective is to "strengthen the global response to climate change, in the context of sustainable development" thereby linking climate change agenda to the SDGs and to Agenda 2030 (UNFCCC, 2015).

Some Key elements of Paris Agreement that directly/indirectly reduce human health risks

- Preamble of the Paris Agreement says "Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, **the right to health,** the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

- *Clause IV* (Enhanced Action Prior to 2020, Paragraph 109) of the Paris Agreement includes "Recognizes the social, economic and environmental value of voluntary mitigation actions and their co-benefits for adaptation, **health** and sustainable development;

- Addressing Article 2.1 (a) of the Paris Agreement ("Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"

- Article 9.1 of the Paris Agreement ("Developed country Parties shall provide financial resources to

assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention") should be implemented as a global commitment to address both mitigation and adaptation in every priority sector including health.

The Sendai Framework for Disaster Risk Reduction, 2015

The Third UN World Conference adopted the "Sendai Framework for Disaster Risk Reduction 2015-2030" on 18 March 2015 in Sendai, Japan. This actually replaced the earlier "Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters".

Some Key elements of Sendai Framework that address health issues at the global level

- Sendai Framework for Disaster Risk Reduction identified four focused priority areas for actions. All priority actions mentioned about the health issues in different clauses/paragraphs (Figure 14 below)
- Priority actions 3 (Investing in disaster risk reduction for residence) comprehensively address health resilience aspects. Some of the major elements are to
- Enhance the resilience of national health systems, including by integrating disaster risk management into primary, secondary and tertiary health care, especially at the local level;
- Developing the capacity of health workers in understanding disaster risk and applying and implementing disaster risk reduction approaches in health work;
- Promoting and enhancing the training capacities in the field of disaster medicine; and supporting and training community health groups in disaster risk reduction approaches in health programmes, in collaboration with other sectors, as well as in the implementation of the International Health Regulations (2005) of the World Health Organization
- Promote the resilience of new and existing critical infrastructure, including water, transportation and telecommunications infrastructure, educational facilities, hospitals and other health facilities, to ensure that they remain safe, effective and operational during and after disasters in order to provide live-saving and essential services;
- Provide psychosocial support and mental health services for all people in need;

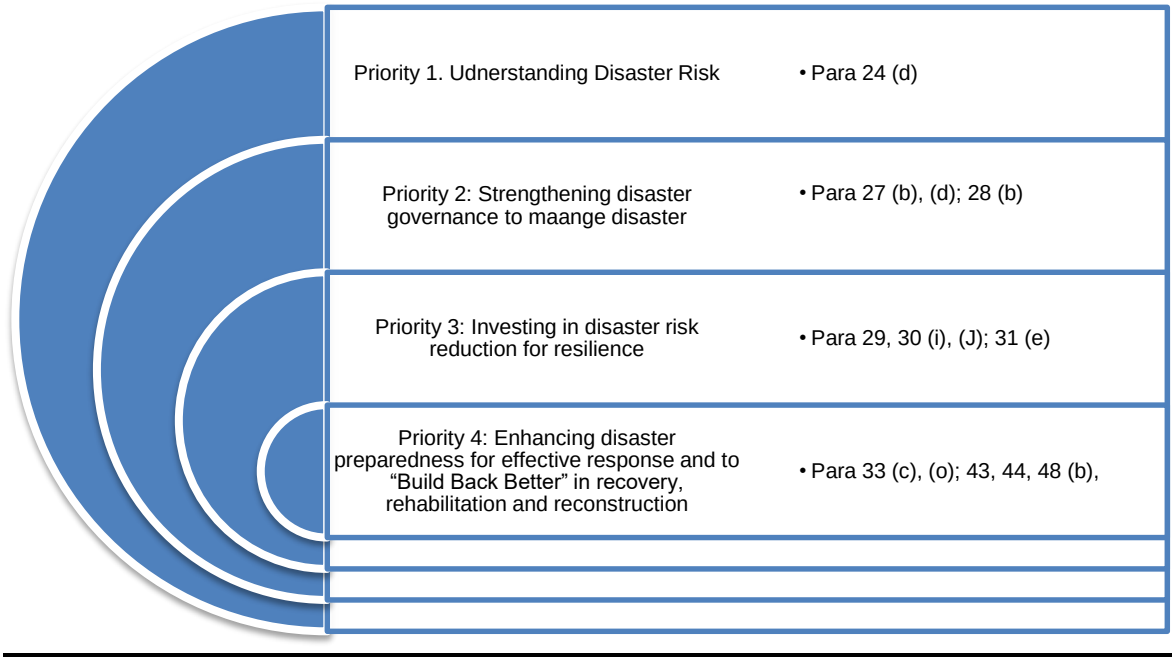

Figure 16. Health issues in Sendai Framework for disaster risk reduction

6.4.2 Key Adaptation strategies to reduce health impacts at the global level

Climate change and climate variability imposes additional pressure on human health, which is intensely induced by adverse impacts in other sectors e.g. agriculture, water and sanitation. Therefore, an integrated approach is needed, combing multiple sectors to strengthen climate resilience. UN agencies including WHO, WMO, WFP, UNDP and other international/multi-national organizations such as World Bank, ADB, IFRC, GEF, DFID implemented 12 large-scale projects to address climate change and health issues in different countries. The World Health Organization (WHO) is working relentlessly to bring about rapid actions that address climate change and air pollution. Issued by various organizations from over 5 million doctors, public health professionals, and 17,000 hospitals from all across 120 countries, the call to action on climate and health for COP 24 made a statement for itself to mobilize the health sector.

IPCC on adaptation in Health Sectors

IPCC (Smith et al., 2014) mainly focuses on a number of areas to adapt with climate adversities in health sector:

- Improvements in public health services functions including
  - ✓ Enhancement of climate sensitive diseases surveillance (e.g. WHO, ECDC);
  - ✓ Monitoring environmental exposures
  - ✓ Improving disaster risk management and early warning system
  - ✓ Strengthening coordination mechanism between health and other sectors

- Developing health adaptation policies and measures
  - ✓ Conducting health vulnerability mapping
  - ✓ Integration of climate change adaptation in health and relevant policy processes
  - ✓ Use of ICT in health adaptation

- Institutional Arrangement to deal with climate change impacts on health
  - ✓ Strengthening "climate and health governance mechanism"
  - ✓ Adequate financing for research on adaptation in health sector
  - ✓ Capacity building at national and sub-national level to deal with climate sensitivity
  - ✓ Partnership on climate change adaptation in health sector

- Financing health adaptation
  - ✓ Allocation of budget on climate change adaptation in health sector

WHO's Climate Resilient Health System

The figure 8 below parades ways of establishing Climate Resilient Health System through six building blocks of the heath system. The blocks have ten components under them justifying the building blocks respectively. Among the six blocks, Health Information System and Service Delivery are the major blocks with three components each. The other blocks are Essential Medical Products and Technology, Leadership and Governance, Financing and Health Workforce.

The Health Information System block has the following components:

- Vulnerability Capacity and Adaptation Assessment- The purpose of this component is to conduct assessment to measure the vulnerability of climate induced health hazard of human beings and also to identify the adaptation options.
- Health Climate Research- The purpose of this component is to conduct research to figure out the level and frequency of health distress due to climate change among human beings.
- Integrated Risk Monitoring and Early Warning- This component will contribute to the building block by monitoring the risk of climate induced health hazard through integrating all the relevant agencies that should be concerned about the types of drawbacks that the diseases will bring along. Solutions are then to be developed using all the types of information available

from all the integrated agencies. Another purpose of the component is also setup an early warning system to prevent as much damage as possible.

The Service Delivery block has the following components:

- Emergency Preparedness and Management- This component is to build an efficient management of emergency preparedness which will respond immediately to any sort of climate induced health related emergency.
- Climate-Informed Health Programmes- The purpose of this component is to make sure all sorts of health programs conducted by any organization are climate-informed. It is also to ensure that health service providers should be aware about the consequences of climate induced health hazards.
- Management of Environmental Determinants of Health- The purpose of this component is to manage the existing local environmental conditions which might ultimately worsen the impacts of climate change and the health effects of climate change. It is also to make sure that there are zero or as less as possible factors to contribute to health damage.

The component of the Financing:

- Climate and Health Financing: This only component of the block is to fulfill the needs of all sorts of financial backup required to prevent climate induced health hazard. This also implies to the financing of other initiatives being taken to tackle climate change.
- Leadership and Governance- This component is directly the block itself and has the purpose of developing better governance and later on substantiate it through leadership of all levels.
- The Health Workforce:
- Health Workforce- The purpose here is to gather and include the entire chain of all types of health service providers and to ensure they are ready together to develop the Climate Resilient Health System.

The Essential Medical Products and Technologies:

- Climate Resilient & Sustainable Technologies and Infrastructure- The purpose of this component, corresponding to its block, is to ensure the availability of the required medical equipment and technologies to help the treatment of patients affected due to climate induced illness. It also has the purpose of building infrastructure and achieving sustainable technology, which are climate resilient.

Figure 17. Climate Resilient Health System (WHO, 2018)

6.5 Module 5. National Adaptation Plan for health Sector/H-NAP

Session 5

National Adaptation Plan for Health Sector/H-NAP

Learning Objectives of the Session:

After attending the session, the participants will able to:

11. To learn about the national policy frameworks that address climate change and health aspects
12. To improve understanding on the institutional arrangement to deal with climate change and health at the national level
13. Gain knowledge on the required major elements to develop climate resilient health system in the country

6.5.1 Key Policy/Strategy/Plan to address climate change and health in Bangladesh

Bangladesh, one of the most emerging developing countries in the world, is struggling in the era of climate change. In spite of being the most vulnerable country of the global climate change, little do the people of this

developing country know about their do's and don'ts. As a result, natural calamities causing in the land of Bangladesh are affecting directly or indirectly to the public health of over 160 million people of this country. Also poor people are becoming poorer and losing the productivity and assets because of the inadequate support from heath care system of the country.

Government of Bangladesh has taken different national plans by following the internationals format of UNFCCC and IPCC. Ministry of Environment, Forests and Climate Change (MOEFCC) of the Government of Bangladesh initiated and developed National Adaptation Programmes of Action (NAPA) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP) to fight against the impacts of climate change particularly on health of it people.

National Adaptation Programmes of Action (NAPA)

In 2005, Government launched its National Adaptation Programme of Action (NAPA) in association with multi-stakeholders, to plan and implement urgent adaptation actions to address climate change (NAPA, 2005). According to UNDP, Bangladesh stands in the 6th position due to the effect of flood and vulnerabilities. NAPA acknowledged the impacts of climate-induced hazards including temperature rise, flood, drought, salinity intrusion, cyclone and storm surges and sea level rise on health of the people. It states that temperature variation and salinity intrusion will significantly affect the health of the people especially in the coastal zone. Therefore, Bangladesh NAPA considered two out of fifteen urgent adaptation actions to address climate change in 2005. These two projects were:

- Mainstreaming adaptation to climate change into policies and programmes in different sectors (focusing on disaster management, water, agriculture, **health** and industry);
- Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise.

Bangladesh Climate Change Strategy and Action Plan

The vision of the Government of Bangladesh is to eradicate the poverty and achieve economic and social development for its people. Therefore, the country wanted to have a comprehensive long-term strategic plan to address climate change in the country. To this end, the inter-ministerial committee led by the Ministry of Planning and senior experts drafted, reviewed, finalized and printed the Bangladesh Climate Change Strategy and Action Plan (BCCSAP).

BCCSAP has programmes with the theme “Food security, Social protection and Health” which ensures about the public health issues due to climate change in Bangladesh. BCCSAP consists of 6 pillars including:

- ✓ Food Security, social protection and **health.**
- ✓ Comprehensive disaster management
- ✓ Infrastructure development
- ✓ Research and Knowledge management
- ✓ Mitigation and low-carbon development
- ✓ Capacity building and institutional development.

Adaptation in health sector is one of the nine programmes under the first pillar, which is food security, social protection and health. The main objective of this programme is to conduct research and monitoring on the impacts of climate change on disease pattern and the social and economic costs of diseases. It also targets to develop adaptation measures for health sectors. BCCSAP identified three major actions as indicated in the following figure 15. However, it guided to conduct research on climate change impacts on health particularly incidences of climate sensitive diseases including malaria, dengue and diarrhea. Actions were also included to identify effective adaptation strategies against the epidemics of climate sensitive diseases.

Theme	T1. Food Security, Social Protection and Health
Programme	P6. Adaptation in health sector
Objective	Research and monitoring on the impacts of climate change on disease patterns and the social and economic costs of disease. Develop adaptative measures
Justification	The 4th IPCC report indicates that one of the major impacts of global warming and climate change will be an increase in vector borne diseases (e.g., malaria and dengue fever). Recent studies by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) demonstrate that diarrhoeal diseases are on the increase, which they attribute partly to increased flooding and drainage congestion. This is expected to get worse with climate change. Global warming will also raise temperatures in the summer season, increasing the incidence of heat strokes, which could be further aggravated by shortages of drinking water. Possible other threats from other vector borne diseases such as Kala-azar and typhoid have yet to be assessed It is important that the monitoring of diseases linked to climate change is upgraded and research undertaken to develop adaptative strategies that can be put in place as needs emerge
Actions	A1. Research on the impact of climate change on health (including the incidence of malaria and dengue, diarrhoeal diseases, heatstroke) and the cost to society of increased mortality, morbidity and consequent fall in productivity A2. Develop adaptive strategies against outbreaks of malaria, dengue and other vector borne diseases and invest in preventive and curative measures and facilities A3. Develop adaptive strategies against diarrhoeal and other diseases, which may increase due to climate change, and invest in preventive and curative measures and facilities

Figure 18. BCCSAP considered adaptation actions in health sector (BCCSAP, 2009)

Seventh five-year plan (2016-2022)

- To take proper steps to manage emerging and re-emerging climate change related health problems.
- Tightening emergency preparedness and reply capacity
- Managing climate related hazards and disasters
- Conduct more research on health sector to find the climate related health diseases
- Addressing environment related health concerns such as access to safe water, lack of sanitation and poor indoor and outdoor air quality

Health Policy, 2011

The health policy, 2011 of the Government of Bangladesh included a dedicated chapter on climate change impacts on health of the people. It recommends monitoring the climate sensitive diseases and identifying the adaptation options to avoid such disastrous impacts.

Third National Communication (TNC)

The government of Bangladesh submitted its Third National Communication (TNC) to United Nations Framework Convention on Climate Change (UNFCCC). The adaptation chapter of the TNC has included a dedicated section on health sector. This section primarily emphasizes on the current impacts, state and trend of climate sensitive diseases in the country. It also highlighted the projected disease burden due to climate change. It highlights the risks on human health and potential adaptation options.

6.5.2 Key Institutions to deal with climate change impacts on health in Bangladesh

There are many institutions that are trying to fight with climate change issues. Many departments and ministries are involved in this process where Ministry of Health and Family Welfare leading on health related issues (MoHFW, 2017). Furthermore, the Ministry has certain responsibilities, which it processes for tackling the issues of climate change. The core responsibilities include- creating national-level policies, plans, and decisions for healthcare and education. This is implemented by taking actions involving various authorities and health care delivery systems. The ministry is divided into two sections that include- Health Services Division and Medical Education and Family Welfare Division.

Ministry of Health and Family Welfare

MOHFW has commenced nine implementing authorities which are Directorate General Health Services (DGHS), Directorate General of Family Planning (DGFP), Directorate General of Drug Administration (DGDA), National Institute of Population Research and Training (NIPORT), Directorate General of Health Economics Unit (DGHEU), Directorate General of Health Engineering Department (DGHED), Directorate General of Nursing and Midwifery (DGNM), Transport and Equipment Maintenance Organization(TEMO), National Electro-medical and Engineering Workshop (NEMEW).

DG Health Services

In the above-mentioned authorities, DGHS is responsible for healthcare-delivery systems spread from national to the community level. All the activities are being implemented from regular revenue setups

to development programs. Under this division, programs are done where the health manager at the Upazila level is responsible for Upazila health and family planning. Health facilities in the union level comprises of three types: rural health centers, Union sub centers, and lastly Union health and family welfare centers (UHFWCs). Union-level health facility involves a medical doctor among the other staffs in each union. All the outdoor facilities are provided at the union level only. Moreover, all union facilities have medical officers to assist the people for their healthcare services.

The government of Bangladesh established a number of organizations with specific mandates, roles and responsibilities to improve human health condition of the country.

DG Health Education

Improved medical education system is essential for the introduction of universal health care. The present government is working to expand the advanced medical system. Efforts are being made to expand the opportunities for meritorious students to get advanced education in medical sciences with a view to upholding quality medical education, modernizing and up-to-date medical education.

To create quality trained manpower in medical education institutions to ensure universal health care is the vision of the directorate. The Strategic Objectives of the division are:

- To strengthen supervision activities in medical educational institutions.
- Creating quality trained manpower in medical education institutions.
- Formulation and updating of laws, rules, policies related to medical education.
- Construction of medical education institutions, development and expansion of physical infrastructure.
- Increasing access to medical education through the establishment of e-libraries.

Climate Change Health Promotion Unit

The Climate Change Health Promotion Unit (CCHPU) was established specifically to strengthen the health systems to combat with adverse impacts of climate change. The objectives of setting this CCHPU up include:

- To coordinate all Health Promotional activities of Intra and Inter Ministerial initiatives.
- To increase awareness of health consequences of climate change;
- To strengthen the capacity of health systems to provide protection from climate-related risks through e-Health and Telemedicine;
- To ensure that health concerns are addressed in decisions to reduce risks from climate change in other key sectors;
- To conduct research, evaluate and monitor programmes related to health promotion and climate change;
- To coordinate emergency medical services and school health promotion to reduce health hazards during disasters and emergencies.

Institute of Epidemiology, Disease Control and Research (IEDCR)

The IEDCR was established long back with a mandate of the institute to advise the government and local bodies on all issues related to malaria, to carryout epidemiological investigations, undertake systematic research. Currently, the IEDCR mainly conducts diseases surveillance, outbreak investigation and response and finally steering research and training on health related issues. IEDCR's on-going surveillance include:

- Cholera surveillance
- Hospital and web-based dengue surveillance
- Foodborne illness surveillance
- Respiratory event based surveillance
- Acute Meningo-Encephalitis Syndrome (AMES) Surveillance

Other International and national organizations/institutions organizations on climate change and health

The World Health Organization (WHO), United Nations Children Fund (UNICEF) and International Diarrheal Diseases Research Bangladesh (ICDDRB) also put emphasize on climate change impacts on human health in their strategy, programmes and project. Each of these above mentioned organizations extend their cooperation with government of Bangladesh to reduce impacts of climate change on human health.
The Municipalities, medical college/University, Hospitals, clinics and other research organizations also play vital role in controlling and managing climate change sensitive diseases across the country.

6.5.3 Development of Climate Resilient Health System in Bangladesh

The World Health Organization (WHO) launched an operational framework for climate resilient health management. South-Asian region countries also stepped forward to find out the health risks which are related to climate change in the region and to implement the framework of WHO, which will help the people's health of this region to adapt with the changing climate. As mentioned in above section 3.4, mainly the framework of WHO covers through 10 components and Bangladesh's climate resilient system can also build the strategies around those component to make sure a health system is climate resilient in the country. These components are also considered in the Draft Health National Adaptation Plan of Bangladesh. The following major elements can be considered to develop a climate resilient health system in Bangladesh, as indicated in Draft HNAP (WHO-IEDCR, 2018; WHO, 2018):

- **Leadership and Governance:** The main target is to have climate change consideration in the health governance mechanism and to secure cross-sectoral cooperation and maximize coordination to make sure that decisions taken in another sectors promote and retain health. It is badly needed to strengthen CCHP Unit with named focal point (fulltime) and adequate budget, formation of a working group with agreed TORs in charge of monitoring, updating and evaluating progress.

- **Health Workforce:** Technical capacity and the institutional mechanisms of MOHFW and CCHPU need to be strengthened to deal with climate change sensitive diseases. The shortage of talented technical stuffs, improper distribution of resources and inadequate financial resources are the main obstacles. It is needed to provide service training to make people conscious on climate change and associated impacts. Through mass media and different communication campaigns it is necessary to improve health education related to climate.
- **Vulnerability, capacity and adaptation assessment:** Proper understanding of the health hazards posed by climate change need to be assessed for different vulnerable population (women, children, elderly, physically and mentally challenged, so on) in different climate prone zones. Adaptation options including their potential cost, advantages and efficiency, challenges to be well understood by both national and sub-national health system.
- **Integrated risk monitoring and early warning:** Develop integrated system to monitor climate sensitive diseases and climate informed early warning system.

- **Health and climate research:** Developing research agenda on climate change and health aspects. Research allocation should be increased and research capacity among workers and professionals need to be strengthened.
- **Technologies, equipment and procedures:** Develop SOPs and effective guidelines for health security. National and sub-national health centers should be well equipped to test and report the climate sensitive diseases
- **Management of environmental determinants of health:** Strengthen air and water quality monitoring.
- **Climate-informed programmes:** Climate change need to be integrated in policy, plans, programmes and projects.
- **Emergency preparedness and management:** Emergency plans should include climate change risks on human health.
- **Climate and health financing:** Develop a financing plan for health adaptation based on the cost benefit analysis.

Session 6

Health and Climate Change in UNFCCC Negotiation Process

Learning Objectives of the Session:

After attending the session, the participants will able:

14. To learn about United Nations Framework Convention on Climate Change and its main target related to human health

15. To improve understanding on the adaptation and mitigation decisions/actions related to address human health

6.6.1 Introduction to United Nations Framework Convention on Climate Change (UNFCCC)

The UN Framework Convention on Climate Change (UNFCCC) is a multilateral treaty to address climate change globally. This treaty was negotiated more than a year and it was opened for signature at the Rio Earth Summit held in June 1992. The UNFCCC (knows as Climate Convention) entered into force on 21 March 1994. The UNFCCC is ratified by 196 states/countries.

As mentioned above, 196 countries/parties regularly attend inter-sessions meeting and Conference of the Parties (CoP) every year. They look at the progress, achievements, and challenges and negotiate for effective solutions under the UNFCCC process. During the last decades, the UNFCCC process has made a number landmark decisions. Some of them include:

- The Kyoto Protocol (KP) was agreed in December 1997 in Kyoto, Japan
- The Copenhagen Accord, 2009
- Cancun Adaptation Framework, 2010
- The Paris Agreement on Climate Change, 2015

Objectives of the UNFCCC

1. ***Stabilization of greenhouse gas*** *concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.*
2. *Such level should be achieved* ***within a timeframe*** *sufficient to* ***allow ecosystems to adapt naturally*** *to climate change, to ensure that* ***food production is not threatened*** *and to enable* ***economic development*** *to proceed* ***in a sustainable manner***

6.6.2 "Health references" in UNFCCC Negotiation Process

- UNFCCC clearly mention about the climate change impacts on the human health (Article 1.1. “Adverse effects of climate change" means changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of socio-economic systems or on **human health** and welfare”
- UNFCCC also mentions about the need of reduction of climate risks on human health (Article 4.1 (f) “Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on **public health** and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change”
- Within the biannual National Communication, both non-ANNEX 1 & ANNEX 1 countries are required to report on **health co-benefits**
- The “Marrakesh Ministerial Declaration” in CoP 7 (2001) recognized different sectors including human health as centre of global attention (…”Recognize that, in this context, the problems of poverty, land degradation, access to water and food and **human health** remain at the centre of global attention; therefore, the synergies between the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, should continue to be explored through various channels, in order to achieve sustainable development”
- The CoP 7 (2001) of UNFCCC also decides that the adaptation activities of different sectors including health will be supported from Special Climate Change Fund and Adaptation Fund.
- CoP 23 President, Prime Minister Bainimarama of Fiji requested World Health Organization (WHO) to prepare a report on climate change and health to be shared at CoP24, held in Katowice, Poland in 2018.

6.6.3 Suggested Health Adaptation Actions by UNFCCC

The UNFCCC Handbook on Vulnerability and Adaptation Assessment identified series of potential adaptation actions to reduce potential health impacts of climate change (Table 5 below).

Table 5. Adaptation options to reduce impacts of climate change on human health

SL	Adaptation Option	Level of implementation	Feasibility for Bangladesh (Y/N)	Priority
1	Interagency cooperation	Global, Regional, National	Y	+++
2	Reduction of social vulnerability	National and Local	Y	++
3	Improvements of public health infrastructure	National and local	Y	+++

4	Early warning and epidemic forecasting	Local	Y	+++
5	Support for infectious disease control	National and local	Y	+++
6	Monitoring and surveillance of environmental, biological and health status	Global, Regional, National and Local	Y	+++
7	Integrated environmental management	Local	Y	+++
8	Urban design (including transport systems)	National, Local	Y	+++
9	Housing, sanitation, water quality	Local	Y	+++
10	Specific technologies (e.g., air conditioning)	National, Local	Y	++
11	Public education	Local	Y	+++

Source: Adapted from UNFCCC, 2010; McMicheal et al., 2000; +++=very important, ++=important; + = less important

6.6.4 Financial Support on Health Adaptation through different financial mechanism of UNFCCC

Global Environment Facility (GEF)

- Under the climate change focal area, GEF (LDCF/SCCF/GEF Trust Fund) supported only 07 projects on health sector since 2001;
- Six of these health related projects are on adaptation and one is on mitigation.
- GEF supported largest (17 Million USD) climate change project on health (Building Resilience of Health Systems in Pacifc Island LDCs to Climate Change) was approved for Kiribati, Solomon Islands, Vanuatu, Tuvalu.
- Over the years, the total financial contribution of GEF on health adaptation/mitigation was only 41.3 million USD
- Bangladesh was part of the 2nd largest project (9 million USD) on climate change and health (Building Resilience of Health Systems in Asian LDCs to Climate Change)

Green Climate Fund

- GCF provided about 35 Million USD to address climate change impacts on human health

- GCF approves two adaptation projects in health sector in Sudan and Cook Island
- Strengthening Capacity of Rural Primary Health Care Services to Address Adverse Impacts of Climate Change on Health (Sudan)
- Building Climate Resilience in Cook Islands People through Better Health and Outreach, Enhancing Sanitation, Being Energy Efficient, and Improving Water Security (Cook Islands)
- GCF supported ten projects in water sector, five projects in agriculture, three projects on food security issues that contribute in health protection in different countries

- GCF also support a number of projects on clean cooking which also contribute in protection of health, particularly of the women.

Adaptation Fund

- Adaptation fund still didn't provide any direct support on health adaptation projects
- AF supported at least 26 adaptation projects (water sector-12, Agriculture-9 and food security-5 projects) that contribute in building health resilience
- The largest project (14 Million USD) of Adaptation Fund is “Building adaptive capacity through food and nutrition security and peace building actions in vulnerable Afro and indigenous communities in the Colombia-Ecuador border area”

6.7 Module 7. Participant’s follow up/Post training Action Plan

Session 7

Participant’s follow up/Post training Action Plan

Objectives of the Session:

- To determine what the trainees/participants have learned during the training
- To get valuable feedback in a systematic manner to improve future training planning and effective climate resilient health management
- To ensure trainees/participants take follow up actions to apply and disseminate their experiences, knowledge and learning attained.

6.7.1 Quiz questions to determine learning from the training sessions

A set of questions will be used to determine the learning of the training sessions. These basic quiz questions will be answered by each of the participants in the following format (next page):

Issues	Session of the Training Course					
	Session 1. Introduction to weather, climate, climate change and variability	**Session 2.** Climate Change and Human Health-Global Perspectives	**Session 3**. Climate Change and Human Health in Bangladesh	**Session 4.** Climate Change and health: Current responses at the global level	**Session 5.** National Adaptation Plan for health Sector/H-NAP	**Session 6.** Health and Climate Change in UNFCCC Processes/Framework
Mention 5 keywords you have learnt from each of the training sessions						
What are the things you appreciated the most from each of the sessions? Why?						
In your current situation, do you miss any knowledge about the topic that was not covered by any of the training session						
Rate how confident you feel about your knowledge on the subject (1=nothing, 5 =everything).						
Overall, what have you learnt from each of the sessions						

6.7.2 Feedback on the overall training

This training event integrates follow-up to offer further support, skill development, and continuous improvement to promote new practices. The feedback from the participants/trainees will help improvement of the modules and conducting the training. The following tool will be used in the last session to get feedback from the participants.

Issues	Session of the training course					
	Session 1. Introduction to weather, climate, climate change and variability	**Session 2.** Climate Change and Human Health-Global Perspectives	**Session 3**. Climate Change and Human Health in Bangladesh	**Session 4.** Climate Change and health: Current responses at the global level	**Session 5.** National Adaptation Plan for health Sector/H-NAP	**Session 6.** Health and Climate Change in UNFCCC Processes/Framework
Is there anything missing in the content?						
Is there anything irrelevant with the session?						
Is there anything missing in the presentation?						
Is there anything irrelevant with the presentation?						
How was the delivery?						

How was the interaction between the trainer and trainees?						
What would you change to improve any of the Training sessions?						

6.7.3 Develop a "Follow Up Action Plan"

It is expected that each of the participants will develop an action plan as a follow up activity. This is mainly to ensure that the trainee is well planned to implement learned skills, knowledge and experiences on their job. Therefore, the trainees will be asked to respond on the following questions to prepare the action plan:

- What steps will you take after the training course to establish climate resilient health system in your Upazilla/district/Bangladesh?
- What do you plan for the following 3 months regarding Training session main topic(s)?
- What will you do to implement a concept from any of the session of the training course?
- When and with whom will you do this?
- What results do you expect and how will they be measured?
- When do you expect to see these results?
- What assistance or support will you need to implement your plan?

7. Session Plan/Guideline

SESSION PLAN/GUIDELINE	
Module 1	**Introduction to weather, climate change and variability**
Learning Objective	• At completing this module, the participant will have a clear understanding on • The basic information about climate change, its causes, and consequences • Introducing the greenhouse effect and greenhouse gases • Gain knowledge on climate change induced hazards and associated impacts at Global and national level (Bangladesh) due to climate change
Duration:	• 1 hour 00 minutes • 45 Minutes Presentation (PPT) • 15 Minute Open discussion
Outline of the course module:	• **Topic: Introduction to weather, climate change and variability** • Outline of the Presentation (indicative): • Learning objective • Concept and basics of weather, climate change, greenhouse effect climate variability • Key terminologies: weather, climate, climate change, climate variability, greenhouse gases, greenhouse effect, heat island • Global and national climate change induced hazards • Climate Change Impacts in Bangladesh (In brief) • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
Resource Person:	
Learning Methods:	• On site learning: PPT presentation & interactive discussion

Key References and background reading materials	• IPCC Fifth Assessment Report (AR5): Climate Change 2014: Impacts, Adaptation, and Vulnerability: https://www.ipcc.ch/report/ar5/wg2/ • Impacts of 1.5°C of Global Warming on Natural and Human Systems: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf • Human Health: Impacts, Adaptation, and Co-Benefits: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf

Module 2	**Climate Change and Human Health-Global Perspectives**
• Learning Objective	• At the end of the session, the participant will be able to • Understand the pathways on how climate change affects human health at the global level • Learn on the observations and projections of climate change and its associated impacts on human health
• Duration:	• 1 hour 00 minutes • 45 Minutes Presentation (PPT) • 15 Minute Open discussion
• Outline of the course module:	• **Topic: Climate Change and Human Health-Global Perspectives** • Outline of the Presentation (indicative): • Learning objective • Introduction to climate change and human health • Climate change sensitive diseases at the global level • *Case Studies on Climate Sensitive Diseases/health disorders at the global level:* • Case Study 1: Dengue fever in Americas Region, Asia, Africa and Australia and the Pacific • Case study 2: Heat waves related health disorders • Case study 3: Drought and health problems • How Climate Change Affects Human Health: Pathways and Mechanism • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
• Resource Person:	•

• Learning Methods:	• On site learning: PPT presentation & interactive discussion
• Key References and background reading materials	• Human Health: Impacts, Adaptation, and Co-Benefits: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf • Cop24 special report health and climate change: https://apps.who.int/iris/bitstream/handle/10665/276405/9789241514972-eng.pdf?ua=1 • World Health Organization, Regional Office for South-East Asia. (2015). Climate Change and Health: Training Modules. WHO Regional Office for South-East Asia. https://apps.who.int/iris/handle/10665/204866

• Module 3	• Climate Change and Human Health in Bangladesh
• Learning Objective	• After attending the session, the participants will able to: • Understand different types of climate sensitive diseases and their state and trend in Bangladesh • Gain knowledge on water related health disorders due to climate change • Learn on vector borne diseases due to climate change in Bangladesh • Provide an understanding on climate change and air quality related diseases/health problems
• Duration:	• 2 Hours 00 minutes • 45 Minutes Presentation (PPT) • 15 Minute Open discussion • 30 Minutes Exercises (Group Work Questions will be shared after the presentation) • 15 Minutes Group Work Presentation • 15 Minutes (Participant's experiences sharing on climate sensitive diseases (what was the disease? How was the treatment? Any good or bad lessons?)
• Outline of the course module:	• **Topic: Climate Change and Human Health in Bangladesh** • Outline of the Presentation (indicative): • Learning objective • Introduction to climate change and human health in Bangladesh

	• Climate sensitive diseases burdens in Bangladesh • Climate Change Impacts in Human Health in Bangladesh • Key Observations and projections on climate change impacts on human health in Bangladesh • Climate change and water borne diseases • Climate change and vector borne diseases • Climate change and food borne diseases • Climate change and air quality related diseases • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
• Resource Person:	•
• Learning Methods:	• On site learning: PPT presentation & interactive discussion; Group Exercise and experiences sharing
• Key References and background reading materials	• Human Health: Impacts, Adaptation, and Co-Benefits: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf • Climate Change and Health Country Profile-Bangladesh: http://www.searo.who.int/entity/water_sanitation/ban_c_h_profile.pdf?ua=1 • Climate change and health impacts: How vulnerable is Bangladesh and what needs to be done? http://documents.worldbank.org/curated/en/836581468004786339/pdf/88665-REVISED-WP-p143457-PUBLIC-Box385193B.pdf • Third National Communication (TNC) of Bangladesh, 2016 • Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

• Module 4	• **Climate Change and health: Current responses at the global level**
• Learning Objective	• After attending the session, the participants will able to: • Understand about the most recent global policy/strategy related to climate change and human health • Provide a brief understanding on global decisions and guidance on climate change and health • Gain knowledge on global adaptation strategies to reduce impacts on human health

• Duration:	• 45 minutes • 30 Minutes Presentation (PPT) • 15 Minute Open discussion
• Outline of the course module:	• **Topic: Climate Change and health: Current responses at the global level** • Outline of the Presentation (indicative): • Learning objective • Key Policy/Strategy that address climate change and health at the global level • United Nations Framework Convention on Climate Change (UNFCCC), 1992 • The Paris Agreement, 2015 • The Sendai Framework for Disaster Risk Reduction, 2015 • IPCC on adaptation options in Health Sectors • WHO's Climate Resilient Health System • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
• Resource Person:	•
• Learning Methods:	• On site learning: PPT presentation & interactive discussion;
• Key References and background reading materials	• Human Health: Impacts, Adaptation, and Co-Benefits: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf • Cop24 special report health and climate change: https://apps.who.int/iris/bitstream/handle/10665/276405/9789241514972-eng.pdf?ua=1 • Impact of climate change on children in Bangladesh https://www.unicef.org/bangladesh/sites/unicef.org.bangladesh/files/2018-10/UNICEF_eBook-impact_Climate_Change.pdf • UNFCCC, 1992: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf • The Paris Agreement, 2015:

	https://unfccc.int/sites/default/files/english_paris_agreement.pdf • The Sendai Framework for Disaster Risk Reduction: https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf

• Module 5	• **National Adaptation Plan for health Sector/H-NAP**
• Learning Objective	• After attending the session, the participants will able to: • To learn about the national policy frameworks that address climate change and health aspects in Bangladesh • To improve understanding on the institutional arrangement to deal with climate change and health at the national level • Gain knowledge on the required major elements to develop climate resilient health system in the country
• Duration:	• 2 Hours 00 minutes • 45 Minutes Presentation (PPT) • 15 Minute Open discussion • 45 Minutes (Group Exercise) [what are the climate sensitive diseases in the country? How do you deal with these diseases now? How best these diseases can be dealt with? What are the policy and institutional gaps? What can be done to overcome these gaps (if there are)] • 15 Minutes (Group Work Presentation)
• Outline of the course module:	• **Topic: National Adaptation Plan for health Sector/H-NAP** • Outline of the Presentation (indicative): • Learning objective ▪ Key Policy/Strategy/Plan to address climate change and health in Bangladesh • National Adaptation Programmes of Action (NAPA), 2005 • Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009 • Seventh Five Year Plan (7FYP), 2016-2020 • Third National Communication (TNC), 2016 • Bangladesh Health Policy, 2011 • Key Institutions to deal with climate change impacts on health in Bangladesh

	• Ministry of Health and Family Welfare (MOHFW) • DG Health Services • Climate Change Health Promotion Unit (CCHPU) • Institute of Epidemiology, Disease Control and Research (IEDCR) • Development of Climate Resilient Health System in Bangladesh • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
• Resource Person:	•
• Learning Methods:	• On site learning: PPT presentation & interactive discussion;
• Key References and background reading materials	• Human Health: Impacts, Adaptation, and Co-Benefits: https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf • National Adaptation Programmes of Action (NAPA), 2005 • Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009 • Seventh Five Year Plan (7FYP), 2016-2020 • Third National Communication (TNC), 2016 • Bangladesh Health Policy, 2011 • Cop24 special report health and climate change: https://apps.who.int/iris/bitstream/handle/10665/276405/9789241514972-eng.pdf?ua=1 •

• Module 6	• **Health and Climate Change in UNFCCC Processes/Framework**
• Learning Objective	• After attending the session, the participants will able to: • To learn about United Nations Framework Convention on Climate Change and its main target related to human health. • To improve understanding on the adaptation and mitigation decisions/actions related to address human health • To gain knowledge on financial support on health related adaptation

	under UNFCCC funding mechanism.
• Duration:	• 45 minutes • 30 Minutes Presentation (PPT) • 15 Minute Open discussion
• Outline of the course module:	• **Topic: Health and Climate Change in UNFCCC Processes/Framework** • Outline of the Presentation (indicative): • Learning objective • Introduction to United Nations Framework Convention on Climate Change (UNFCCC) • Health references" in UNFCCC Negotiation Process • Suggested Health Adaptation Actions by UNFCCC • Financial Support on Health Adaptation through different financial mechanism of UNFCCC • GEF (Least Developed Countries Fund/Special Climate Change Fund/GEF Trust Fund) • Green Climate Fund • Adaptation Fund • Additional Note: Relevant updated maps, graphs, info-graphs from authentic (updated) sources can be included
• Resource Person:	•
• Learning Methods:	• On site learning: PPT presentation & interactive discussion;
• Key References and background reading materials	• United Nations Framework Convention on Climate Change: https://unfccc.int/ • GEF project database: https://www.thegef.org/projects • Adaptation Fund Project Database: https://www.adaptation-fund.org/projects-programmes/project-information/projects-table-view/ • Green Climate Fund supported project database: https://www.greenclimate.fund/library/-/docs/list/573365

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