This Regional Strategy for Protecting Health from Climate Change has been developed to fulfil the decisions taken at the twenty-fifth, twenty-sixth and twenty-seventh Meetings of Ministers of Health of the Member States of the South-East Asia Region held in Thimphu, Bhutan in 2007; in New Delhi, India in 2008, and in Kathmandu, Nepal in 2009. These meetings urged WHO to formulate a regional strategy to combat the adverse health impacts of climate change. WHO was also requested to provide technical support for applied research, facilitate knowledge-sharing between Member States, assist in resource mobilization and facilitate regional coordination to voice common concerns at the United Nations Framework Convention on Climate Change (UNFCCC). In addition, the Regional Committee in 2009 (SEA/RC62/R2) urged the WHO Regional Office for South-East Asia to develop a strategy for funding health-related climate action plans. This document is expected to assist Member States in developing, strengthening and updating their national strategies and plans of action on climate change and health.
Regional Strategy for Protecting Health from Climate Change
Contents

Page

Acknowledgements ........................................................................................................ v

Abbreviations .................................................................................................................. ix

1. Background ................................................................................................................ 1
   1.1 Introduction ............................................................................................................. 1
   1.2 Effects and impacts of climate change on health ................................................... 4

2. Strategic actions .......................................................................................................... 20
   2.1 Assessment of vulnerability ..................................................................................... 20
   2.2 Adaptation to climate change ................................................................................... 26
   2.3 Mitigation of greenhouse gas emission ...................................................................... 57
   2.4 Research, monitoring and evaluation ...................................................................... 60
   2.5 Financing for adaptation ......................................................................................... 61

3. References .................................................................................................................. 65

Annex

Logframe of the Regional Strategy to Protect Health from Climate Change ........... 85
Acknowledgements

The original draft of this Regional Strategy for Protecting Health from Climate Change was prepared by Dr A M Zakir Hussain, Scientist (Regional Advisor), Environmental Health & Climate Change, Department of Sustainable Development & Healthy Environment (SDE), Regional Office for South-East Asia of the World Health Organization. The manuscript was reviewed by Dr J P Narain, the erstwhile Director SDE, SEARO and Dr Poonam Khetrapal Singh, the erstwhile Deputy Regional Director of SEARO. It was subsequently also reviewed by Dr Athula Kahandaliyanage, the present SDE, SEARO.

Other colleagues who gave their valuable support in developing the first draft of this document are:

(1) Dr Suvajee Good, Regional Advisor, Health Promotion and Education
(2) Dr Sara Varughese, Regional Adviser, Disability and Rehabilitation
(3) Ms Payden, Regional Advisor, Water, Sanitation and Health, and
(4) Dr A. Gunasekar, National Professional Officer – Malaria and Vector-borne Diseases, WHO India Office.

We gratefully acknowledge the support from the following focal points for climate change in the ministries of health and the ministries of environment of Member States of the South-East Asia Region which enriched the document.

(1) Ms Rashada Akhter, Deputy Secretary, Ministry of Health and Family Welfare, Government of the People’s Republic of Bangladesh, Dhaka
(2) Ms Hasnun Nahar, Deputy Secretary, Ministry of Environment and Forests, Government of the People’s Republic of Bangladesh, Dhaka
(3) Ms Rada Dukpa, APO, Department of Public Health, Thimphu
(4) Mr Manoj Pant, Director, NCD, Ministry of Health and Family Welfare, Government of India, New Delhi

(5) Mr Anand Kamavisdar, Scientist D, Climate Change Programme Division, Ministry of Science and Technology, Technology Bhavan, New Delhi

(6) Dr Ann Natallia Umar, Staff Subdirectorate Healthy Settlement and Public Places, Directorate of Environmental Health, Ministry of Health, Jakarta, Indonesia

(7) Mr Zammath Khaleel, Environment Analyst, Ministry of Housing and Environment, Male

(8) Ms Aminath Shaufa, Public Health Programme Coordinator, Centre for community health and Disease Control, Male

(9) Prof. Ms Kyi Kyi Thin, Professor/Head, Department of Microbiology, University of Medicine (1), Yangon

(10) Mr Sahadev Rayamajhi, Section Officer, Ministry of Environment, The Government of Nepal, Singh Durbar, Kathmandu


(12) Miss Theechat Boonyakarnkul, Public Health Technical Officer, Department of Health, Nonthaburi

(13) Miss Oranuch Ratana, Environmentalist, Practitioner Level, Office of Climate Change Coordination, Ministry of Natural Resources and Environment, Nonthaburi

(14) Mr Augusto Lourdes da Silva, Technical Adviser, Ministry of Economy and Development, Democratic Republic of Timor-Leste, Dili, Timor-Leste

Resource persons and temporary advisors who also contributed actively during the workshop on the draft document are as below:

(1) Dr Alok Kumar Deb, Scientist D, National Institute of Cholera and Enteric Diseases, Kolkata, India

(2) Dr Nitish Dogra, Assistant Professor, International Institute of Health Management and Research (IIHMR), New Delhi, India
(3) Dr M Iqbal Kabir, Coordinator, Climate Change and Health Promotion Unit and National Tobacco Control Cell, MOHFW and Assistant Professor, Dept of Epidemiology, National Institute of Preventive & Social Medicine (NIPSOM), Dhaka, Bangladesh

(4) Ms Sreeja Nair, Associate Fellow, Climate Change Division, The Energy and Resource Institute (TERI), New Delhi, India

(5) Professors Rohini de A. Seneviratn, A. Pathmeswaran of the Department of Community Medicine, University of Colombo, Sri Lanka.
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
</tr>
<tr>
<td>CO2</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>COP</td>
<td>Conference of Parties</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>DALY</td>
<td>disability-adjusted life year</td>
</tr>
<tr>
<td>DG</td>
<td>Director-General</td>
</tr>
<tr>
<td>DRR</td>
<td>disaster risk reduction</td>
</tr>
<tr>
<td>DWD</td>
<td>German Weather Service</td>
</tr>
<tr>
<td>EB</td>
<td>WHO Executive Board</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental impact assessment</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Niño Southern Oscillation (current direction and the sea water temperature in the Pacific)</td>
</tr>
<tr>
<td>FDI</td>
<td>foreign direct investment</td>
</tr>
<tr>
<td>EPA</td>
<td>US Environmental Protection Agency</td>
</tr>
<tr>
<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>GHG</td>
<td>greenhouse gases</td>
</tr>
<tr>
<td>GIS</td>
<td>geographical information systems</td>
</tr>
<tr>
<td>GLOF</td>
<td>glacial lake outburst flood</td>
</tr>
<tr>
<td>HAB</td>
<td>harmful algal blooms</td>
</tr>
<tr>
<td>HADCM3</td>
<td>Hadley Centre of the UK Met Dept (version 3 of the climate forecasting tool)</td>
</tr>
<tr>
<td>HIA</td>
<td>health impact assessment</td>
</tr>
<tr>
<td>HiAP</td>
<td>Health in all policies</td>
</tr>
<tr>
<td>HOPE</td>
<td>hospital preparedness in emergencies</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>HPS</td>
<td>hanta minus pulmonary syndrome</td>
</tr>
<tr>
<td>IASC</td>
<td>Inter-Agency Standing Committee of UN for Interagency Coordination of Humanitarian Assistance</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
</tr>
<tr>
<td>M&amp;E</td>
<td>monitoring and evaluation</td>
</tr>
<tr>
<td>NGO</td>
<td>nongovernmental organization</td>
</tr>
<tr>
<td>NHWP</td>
<td>National Heat Wave Plan (of France)</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration, USA</td>
</tr>
<tr>
<td>PCB</td>
<td>polychlorinated biphenyl</td>
</tr>
<tr>
<td>PRECIS</td>
<td>providing regional climates for impacts studies</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>research and development</td>
</tr>
<tr>
<td>RC/R</td>
<td>Regional Committee/ Resolution</td>
</tr>
<tr>
<td>SAD</td>
<td>seasonal affective disorder</td>
</tr>
<tr>
<td>TB</td>
<td>tuberculosis</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environmental Programme</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>USEPA</td>
<td>US Environmental Protection Agency</td>
</tr>
<tr>
<td>UVR</td>
<td>ultraviolet radiation</td>
</tr>
<tr>
<td>VOC</td>
<td>volatile organic compounds</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
1. **Background**

1.1 **Introduction**

Between 1960 and 2007, extreme temperature events had increased 25-fold, followed by a 10-fold increase in floods, a four-fold increase in storms and a two-fold increase in droughts. “Eighty-three per cent of all people affected by drought, 97% of all people affected by flood, and 92% of all people affected by storms over the period 1960–2007 resided in the East Asia and Pacific, and South Asia regions”\(^1\).

Climate and weather extremes are manifested also through food insecurity, social disruption and population displacement, and favour spread of communicable diseases\(^2\). Climate change may be responsible for hazards as diverse as heat waves and cold spells, smog and wildfires, and other events\(^3\). In the 1990s, on an average, major natural catastrophes alone caused economic losses of US$ 66 billion a year at 2002 prices\(^4\), either physically or through the loss of property or livelihood. From 1960 to 2008, economic losses from flooding in the South and South-East Asia Region, estimated to exceed US$ 300 billion, represent resources diverted from productive investments, compromising progress toward the Millennium Development Goals (MDGs)\(^5\). Loss of income from tourism in some of the Regional countries will jeopardize their present rate of development, and will also affect the attainment of their health goals. Mental disorders, that have been recorded to happen as an aftermath of a disaster, may be the consequence of economic loss and/or bereavement\(^6\).

Economic losses may in fact be more devastating. For example, one third of the Sri Lanka's population, 24% of the land area, more than 80% of fish production, rich mineral resources, tourism and 80% of industries are situated in the coastal regions of Sri Lanka. Coastal contribution to the gross domestic product (GDP) increased gradually to 40% by 1989\(^7\). The condition in Bangladesh, in the Region, in particular is also quite precarious.
Agriculture in the South-East Asia (SEA) Region accounted for 43% of total employment in 2004 and contributed about 11% of the GDP in 2006. This makes the Region vulnerable to droughts, floods and tropical cyclones. Its economic dependence on natural resources and forestry also puts it at risk. The incidence of poverty remains high – about 93 million as of 2005. About 19% of South-East Asians still live below the US$ 1.25-a-day poverty line on average, who again are the most vulnerable to climate change.

Changing precipitation patterns, rising annual mean temperatures and melting glaciers is and will cause a serious survival problem for about 1.5 billion South Asians. It may be noted in this regard that of the 16 most climate-vulnerable countries globally, 10 are in Asia.

In its report, the National Oceanic and Atmospheric Administration (NOAA) of the USA suggests that climate change is “largely irreversible for 1000 years,” with permanent dust bowls around the globe. Irreversible precipitation changes have hit the US, South-West and South-East Asia, Eastern South America, western Australia, southern Europe, southern Africa and northern Africa. These will have implications on global developmental support provided to developing countries by developed countries.

Global warming will change and increase the prevalent endemic diseases both spatially, temporally and in magnitude. While new diseases may make their advent, the most common diseases that might be experienced in future are given in Table 1.

Figure 1. Number of natural disasters worldwide between 1975 and 2010
Global warming will increase the presently prevalent endemic diseases spatially and in magnitude. While new diseases may make their advent, the most common diseases that might be experienced in future are as below (Table 1).

**Table 1. Agents and infectious diseases with suspected or known links to landscape change**

<table>
<thead>
<tr>
<th>Vector-borne and/or zoonotic</th>
<th>Soil</th>
<th>Water</th>
<th>Human</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>Melioidiosis</td>
<td>Schistosomiasis</td>
<td>Asthma</td>
<td>Haemorrhagic fevers</td>
</tr>
<tr>
<td>Dengue</td>
<td>Anthrax</td>
<td>Cholera</td>
<td>TB</td>
<td>Foot and mouth</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>Hookworm</td>
<td>Shigellosis</td>
<td>Influenza</td>
<td>Rice blast</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Coccidioidomycosis</td>
<td>Rotavirus</td>
<td></td>
<td>Triachoma</td>
</tr>
<tr>
<td>Rift Valley fever</td>
<td>Salmonellosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td></td>
<td>Leptospirosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td></td>
<td>Cryptosporidiosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plague</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filariasis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kyasanur Forest fever</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hantavirus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nipah virus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.2 Effects and impacts of climate change on health

Extreme and sudden weather conditions

Glacial lake outburst flood (GLOF) events in the past have caused colossal economic losses in Bhutan\textsuperscript{14} and Nepal\textsuperscript{15}. Continuing glacier retreat in some areas and intensification of monsoon rains elsewhere will create variability in river flow in the highlands of the subcontinent\textsuperscript{9}. The Himalayan glaciers feed seven major Asian rivers, ensuring a year-round water supply for two billion people. Glacial retreat will therefore create water stress in the Region. Since 1977, the duration of the monsoon has become shorter due to late onset and early withdrawal, and the strength of the monsoon has also decreased in the Himalayas. By and large, precipitation has become spatially variable globally. Floods will destroy habitats and cause death and injury; together with drought, these will damage standing crops leading to malnutrition and further poverty. Drought can also increase respiratory diseases due to dust storms. Floods and coastal storms cause migration, change in occupation, spreading of slums, poverty and psychological distress.

Increase in the frequency and duration of severe heat waves and humid conditions during the summer is likely to increase the risk of mortality and morbidity, principally among the elderly and urban poor populations\textsuperscript{16}. High temperature and poor urban air quality would be likely to contribute to widespread heat stress and smog-induced illnesses in urban populations\textsuperscript{17}, besides a fall in agro outputs\textsuperscript{17–22}. The management of heat stress conditions, however, is fraught with the lack of a definition of vulnerability to heat stress, lack of community-based data, poor understanding of what might be the triggering temperature, lack of standard diagnostic criteria and capacity to diagnose heat stress with a lead time, lack of scope to report heat stress in the present routine reporting forms, ineffective practices of measuring temperature and rainfall, absence of supportive policy and strategy, and lack of training of health staff.

Loss of life and injuries such as drowning, physical damage, dislocation, fire, material loss, mental stress and suicide occur from more intense and frequent, sudden extreme weather events. Consequent poverty and other after-effects will also overwhelm the capacity of the health sector
to respond, as the health infrastructure itself may be vulnerable to the extreme weather.

The World Health Organization (WHO) estimates that the warming which has already occurred in the past 30 years is responsible for over 150 000 deaths annually and 5 million disability-adjusted life years (DALYs) lost due to increasing rates of mortality and morbidity from extreme heat, cold, droughts or storms; significant changes in air and water quality; and changes in the ecology of a wide range of microbial diseases.

Many of these deaths occur in low-lying coastal areas and small-island nations, which are especially at risk from sea-level rise, storms and microbiological threats from the ocean. In general, vulnerability to the impact of climate change is a function of societal characteristics in combination with climatic, geographical and other phenomena. Climate change kills about 315 000 people a year through hunger, sickness and disasters. This will probably rise to half a million by 2030. Climate change affects 325 million people seriously every year and this figure will double in 20 years, i.e. it will affect 10% of the global population. Economic loss, which is about US$ 125 billion per year, is expected to rise to US$ 325 billion.

**Slowly evolving conditions as an impact of climate change**

**Environmental and climatic causes**

**Water, air and sanitation**

Rainfall patterns and storms influence the transport and distribution of infectious agents. WHO reports that climate-sensitive marine biotoxins cause poisoning of scromboid fish, shellfish and ciguatera, thereby affecting human life. Waterborne diseases, such as diarrhoeal diseases, are also influenced by El Niño. Correlation has been found between annual rainfall, the number of rainy days, and the incidence of malaria.

Twenty-four per cent of the global disease burden and 23% of all deaths can be attributed to environmental factors. Children less than five years of age bear more than 40% of this burden. Close to half of all
people in developing countries suffer at any given time from a health problem caused by water and sanitation deficits. WHO estimates that improving the water supply would reduce the diarrhoeal morbidity rate by 21%, and improving sanitation as well would reduce the rate by 37.5%. Poor water and sanitation also have socioeconomic implications, such as 443 million school days each year are lost from water-related illnesses, which lead to poverty in adulthood.

Waterborne diseases account for 60 million DALYs lost each year or 4% of the global total DALYs. According to WHO, diarrhoea is responsible for the loss of 73 million DALYs, acute respiratory tract infection for 95 million DALYs, malnutrition for 39 million DALYs and neglected tropical diseases for 19 million DALYs; all of which are directly or indirectly related to sanitation. Worldwide, diarrhoea, acute respiratory infections, malaria and immunisable diseases account for 70% of the deaths among children aged 0–4 years.

Foodborne diseases account for an estimated 76 million episodes of illness, 325,000 hospitalizations and 5,200 deaths in the USA alone per year. Globally, at least three million children below the age of 5 years die each year due to environment-related diseases such as diarrhoeal and acute respiratory diseases while two thousand million people in total are at risk for waterborne and foodborne diarrhoeal diseases. The burden of diarrhoea and malnutrition attributable to climate change is the highest, globally in South-East Asia.

Floods result from the interaction of rainfall, surface runoff, evaporation, wind, sea level and local topography. Water management practices, urbanisation, intensified land use and forestry can substantially alter the risks of floods. Windstorms are often associated with floods. In any vulnerability analysis these factors therefore would be important nonclimatic, environmental factor to be considered. Flooding may lead to contamination of water with dangerous chemicals, heavy metals and other hazardous substances, from storage or from chemicals already in the environment (such as pesticides). Chemical contamination following Hurricane Katrina in the USA included oil spills from refineries and storage tanks, pesticides, metals and hazardous waste (although concentrations of most contaminants were within acceptable short-term levels, except for lead and volatile organic compounds in some areas). There are also health
risks associated with long-term contamination of soil and sediment; however, there is little published evidence of a causal effect of chemical contamination on the pattern of morbidity and mortality following flooding. Increases in population density and accelerating industrial development in areas subject to natural disasters increase the probability of future disasters and the potential for mass human exposure to hazardous materials released during disasters.38

Populations with poor sanitation infrastructure and high burdens of infectious disease often experience increased rates of diarrhoeal diseases after flood events. Increases in cholera, cryptosporidiosis and typhoid fever have been reported in low- and middle-income countries. Flood-related increases in diarrhoeal disease have also been reported in India, Brazil and Bangladesh. The floods in Mozambique in 2001 were estimated to have caused over 8,000 additional cases and 447 deaths from diarrhoeal disease in the following months. Hurricanes Katrina and Rita in the USA in 2005, where contamination of water supplies with faecal bacteria led to many cases of diarrhoeal illness and some deaths.38

There is evidence that diseases transmitted by rodents sometimes increase during heavy rainfall and flooding because of altered patterns of human–pathogen–rodent contact. There have been reports of flood-associated outbreaks of leptospirosis in Central and South America and South-East Asia. Risk factors for leptospirosis for peri-urban populations in low-income countries include flooding of open sewers and streets during the rainy season. Cases of hantavirus pulmonary syndrome (HPS) were first reported in Central America (Panama) in 2000, and a suggested cause was the increase in peri-domestic rodents following increased rainfall and flooding in surrounding areas.38

Extreme rainfall and runoff events may increase the total microbial load in watercourses and drinking-water reservoirs, although the linkage to cases of human disease is less certain. A study in the USA found an association between extreme rainfall events and monthly reports of outbreaks of water-borne disease. The seasonal contamination of surface water in early spring in North America and Europe may explain some of the seasonality in sporadic cases of water-borne diseases such as cryptosporidiosis and campylobacteriosis. The marked seasonality of cholera outbreaks in the Amazon has been found to be associated with low
river flow in the dry season, probably due to pathogen concentrations in pools\textsuperscript{38}.

Background levels of ground-level ozone have risen since pre-industrial period because of increasing emission of methane, carbon monoxide and nitrogen oxides. This trend is expected to continue over the next five decades. Changes in concentrations of ground-level ozone due to future emissions and/or weather patterns have been projected for Europe and North America. Higher water vapour and higher stratospheric input and increases in regional ozone pollution, due to higher temperatures and weaker circulation are expected. Climate change may cause significant air-quality degradation by changing the dispersion rate of pollutants, the chemical environment for generation of ozone and aerosol, and from the strength of emissions from the biosphere, fires and dust. The sign and magnitude of these effects will vary regionally as trans-boundary transport of pollutants plays a significant role in determining local to regional air quality. Changing patterns of atmospheric circulation at the hemispheric to global level are likely to be as important as regional patterns for future local air quality\textsuperscript{38}.

Certain weather patterns enhance the development of the urban heat island, the intensity of which may be important for secondary chemical reactions within the urban atmosphere, leading to elevated levels of some pollutants\textsuperscript{38}. Ground-level ozone is both naturally occurring and, as the primary constituent of urban smog, is also a secondary pollutant formed through photochemical reactions involving nitrogen oxides and volatile organic compounds, coming from the exhaust of transports, in the presence of bright sunshine with high temperatures. Temperature, wind, solar radiation, atmospheric moisture, venting and mixing affect both the emissions of ozone precursors and the production of ozone. Concentrations of ground-level ozone are increasing in most regions. Exposure to elevated concentrations of ozone is associated with increased hospital admissions for pneumonia, chronic obstructive pulmonary disease, asthma, allergic rhinitis and other respiratory diseases, and with premature mortality. Outdoor ozone concentrations, activity patterns and housing characteristics, such as the extent of insulation, are the primary determinants of ozone exposure\textsuperscript{38}. Increase in the incidence of asthma, allergic rhinitis and bronchitis were also reported due to increase in air pollutants, allergens and ground-level ozone, fanned by soil fungi, moulds and microorganisms\textsuperscript{39}. 
Air-pollution concentrations are the result of interactions between variations in the physical and dynamic properties of the atmosphere on time-scales from hours to days, atmospheric circulation features, wind, topography and energy use. Some air pollutants are related to weather-related seasonal cycles. Topography may restrict the dispersion of pollutants and thus may concentrate it in a defined locality\(^{38}\). Evidence for the health impacts of particulate matter (PM) on the other hand, has been found to be stronger than that for ozone. PM is known to affect morbidity and mortality, so increasing concentrations would have significant negative health impacts\(^{38}\).

Warming of the atmosphere will worsen the quality of air by decreasing the density of air and thus facilitating the spread of airborne pathogens. WHO ranks urban indoor air pollution as the tenth leading cause of preventable deaths contributing to the global burden of diseases\(^{40}\). In South-East Asian cities, air pollution causes 530,000 premature deaths per year from respiratory problems (including cardiovascular problems). In addition, life expectancy is shortened due to long-term exposure to traffic-related air pollution. In 2000, according to another estimate, out of 2.3 million deaths due to respiratory infections in the SEA Region, close to 750,000 (33\%) were due to air pollution\(^{40}\). Better enforcement and further improvement of air pollution standards would lower the levels of certain fine particulate matter and could bring these deaths down by 15\% a year\(^{40}\). Of the 15 cities in the world with the highest levels of particulate matter, 12 are in Asia\(^{41}\). Since 2000, however, megacities in Asia have shown improvements in air quality due to better traffic planning, introduction of unleaded fuel, construction of urban mass rail systems and control of smoke emissions from transport.

The World Bank suggests that reduced exposure to environmental health risks could result in economic savings equivalent to as much as 3.5\% of the GDP\(^{42}\). It also suggests that diarrhoeal diseases caused by inadequate access to safe water, lack of sanitation and poor hygiene may contribute up to 10\% to the total burden of disease.

Water also provides niches and breeding sites to some dreaded vectors. Over a million people die each year from malaria\(^{37}\) against 267 million infected. The other common water related vector borne diseases in the Region are: filariasis, with 90 million infections globally, onchocerciasis
with 18 million infections and dengue fever with 30–60 million infections globally every year\textsuperscript{30,33}.

Climate change is further aggravating the environment related diseases. According to WHO, in 2000, climate change was estimated to be responsible for approximately 2.4% of diarrhoea and 6% of malaria worldwide in some middle-income countries\textsuperscript{38}, children under five years of age constituting 85% of those who die as a result of climate change\textsuperscript{38,43}. The health threat that climate change presents is not only one of potentially new diseases and emergence of new strains of viruses, but also changes in the incidence, range, intensity and seasonality of existing health disorders\textsuperscript{44}. Drought can also increase or decrease vector efficiency and related diseases within a short time span, followed by a decrease in the long run\textsuperscript{45}.

Anthropogenic behaviour in the past 30 years has claimed, in 2000, at least 77 000 of the 154 000 deaths in SEA Region\textsuperscript{46,47}. The World Health Report 2002\textsuperscript{38} estimated that about 82 000 people died due to climate change in South-East Asia in 2000.

Altered rainfall patterns and storms due to climate change are thought to induce the emergence/re-emergence of vector-borne diseases such as dengue and scrub typhus as major communicable diseases of public health concern\textsuperscript{48}. It is estimated that 95% of the global dengue burden is attributable to climate change\textsuperscript{30}. Approximately 6 billion people may be at risk for contracting dengue fever as a consequence of climate change by 2085, 2.5 billion more than if the climate was to remain unchanged\textsuperscript{17}. In Indonesia, between 2006 and 2007, cases of dengue fever increased by close to 50% during and after the annual rains. Dengue was not seen in 1986–1988 in the His Hseng township of Myanmar, about 3 012 feet above sea level; but since 2005, dengue has become endemic there. Taungzi township, which is 4 912 feet above sea level, had a similar. Bhutan and Nepal are reporting cases of dengue for the first time since 2006. Mosquitoes transmitting dengue were prevalent at a height of 500 m above sea level but are now sighted at an altitude of 2200 m in Darjeeling, India, and 4000 m in Nepal. Dengue was almost unknown in Bangladesh before 2001. Dengue now shows double yearly peaks in Sri Lanka. Thailand has noticed a 10% increase in dengue incidence with each degree of rise in temperature. In 2005, the estimated number of people at risk for dengue in the Region was 1.3 billion – 52% of the global estimate of 2.5
billion. Maldives has been malaria free since 1984, but is now bracing up for a re-emergence of the disease\textsuperscript{46,47}. Bangladesh has been reporting deaths due to Nipah virus encephalitis among the rural population since the past decade\textsuperscript{48}.

Deaths are predicted to increase from non-communicable diseases also such as heat stroke, cardiovascular diseases \textsuperscript{48,49}. Meningitis\textsuperscript{50} and food poisoning\textsuperscript{51} have also been related to climate change.

Climate change is likely to induce increased use of pesticides and insecticides to ward off a surge of insects. As a result of the indiscriminate use of these chemicals, there might be a higher incidence of premature delivery, low birth-weight babies, birth defects, gynaecological cancers, changes in the onset of puberty, anaemia, and kidney diseases\textsuperscript{52}.

The potential threats from improper waste disposal into the sea from coastal cities and from industrial belts into water bodies such as rivers and seas can cause: (i) algal blooms on coral colonies, thereby killing them and changing the composition of fish species and biomass\textsuperscript{38}; (ii) oxygen depletion, causing death of fish; (iii) silt formation and smothering resulting in death of corals; and (iv) microbial pollution, causing health threats to swimmers and contaminating seafood\textsuperscript{53}. These will be aggravated by the increasing warmth and acidity of the sea water.

The acidity of oceans has increased by 30\%\textsuperscript{54} and warming is increasing by 0.1°C per year\textsuperscript{55}. These are also causing coral bleaching, putting the sea fish and birds under threat. Roughly 60\% of Indonesians’ dietary protein comes from the sea, much of it from reef fish, 70\% of which is in poor to fair condition right now\textsuperscript{42}. Food and nutrition may thus be staring at a threat in coastal Member States, if efficient coast management is not done. Fishermen may have to fish deeper or in other-than-usual places, raising fishing costs due to travel and ice costs, resulting in higher market prices\textsuperscript{38}. Extreme weather can destroy landing sites, boats and gear. Various reasons for a lower yield and higher prices will affect nutrition. It is thought that soon the annual economic benefits from global marine fisheries will be reduced by about US$ 50 billion a year\textsuperscript{5}. All these dynamics will also influence migration.
Ultraviolet radiation

Solar ultraviolet radiation (UVR) exposure causes a range of health impacts. Globally, excessive solar UVR exposure has caused the loss of approximately 1.5 million disability-adjusted life years (DALYs) (0.1% of the total global burden of disease) and 60 000 premature deaths in the year 2000. The greatest burdens result from UVR-induced cortical cataracts, cutaneous malignant melanoma, and sunburn and other malignant neoplasms and other diseases of the skin and subcutaneous tissue. Ultraviolet rays cause sunburn, photo-ageing of the skin, reactivation of herpes of the lip, and cataracts and pterygium\(^{48,49}\) (although the latter estimates are highly uncertain due to the paucity of data). UVR exposure may weaken the immune response to certain vaccines, which would reduce their effectiveness\(^\text{38}\).

Climate change will alter human exposure to UVR exposure in several ways, although the balance of effects is difficult to predict and will vary depending on location and present exposure to UVR. Greenhouse gas induced cooling of the stratosphere is expected to prolong the effect of ozone-depleting gases, which will increase levels of UVR reaching some parts of the Earth’s surface. Climate change will alter the distribution of clouds which will, in turn, affect UVR levels at the surface at different topographic and geographic regions. Higher ambient temperatures will influence clothing choices and time spent outdoors, potentially increasing UVR exposure in some regions and decreasing it in others. If immune function is impaired and vaccine efficacy is reduced, the effects of climate-related shifts in infections may be greater than would occur in the absence of high UVR levels\(^\text{38}\).

Temperature

Rise in temperature and humidity may decrease the incubation period of Plasmodium, and increase in the transmission potential and survival of Anopheles\(^\text{56}\). There may be an escalation in the incidence of some endemic diseases due to a longer and untimely exposure period of the people to these disease agents, longer period of communicability, greater virulence of pathogens, and more aggressive dynamics of vectors, such as survival and active life for longer periods, more frequent feeding and breeding, faster maturation of pathogens, and shifting of diseases and vectors from one niche to another. Other diseases have already started to rise in number,
such as salmonellosis in Australia, while the bluetongue virus (animal virus shows a northward expansion). Several studies have confirmed and quantified the effects of high temperatures on common forms of food poisoning, such as salmonellosis. These studies found an approximately linear increase in reported cases with each degree increase in weekly or monthly temperature. Temperature is much less important for the transmission of Campylobacter. Contact between food and pest species, especially flies, rodents and cockroaches, is also temperature-sensitive. Fly activity is largely driven by temperature rather than by biotic factors.

The distribution of schistosomiasis, a water-related parasitic disease with aquatic snails as intermediate hosts, may be affected by climatic factors and warming. In one area of Brazil, the length of the dry season and human population density were the most important factors determining schistosomiasis distribution and its abundance. There was an inverse association between the prevalence rates and the length of the dry period. Recent studies in China indicate that the increased incidence of schistosomiasis over the past decade may in part reflect the recent warming trend. The critical ‘freeze line’ limits the survival of the intermediate host (Oncomelania water snails) and the transmission of the parasite Schistosoma japonicum. The freeze line has moved northwards, putting an additional 20.7 million people at risk of schistosomiasis.

A systematic review of studies of the El Niño-Southern Oscillation (ENSO) and malaria concluded that the impact of El Niño on the risk of malaria epidemics is well established in parts of southern Asia and South America. Evidence of the predictability of unusually high or low malaria anomalies from both sea-surface temperature and multi-model ensemble seasonal climate forecasts in Botswana supports the practical and routine use of seasonal forecasts for malaria control in southern Africa.

Higher temperature was found to be strongly associated with increased episodes of diarrhoeal disease in adults and children in Peru. Associations between monthly temperature and diarrhoeal episodes have also been reported in the Pacific islands, Australia and Israel. Although there is evidence that the bimodal seasonal pattern of cholera in Bangladesh is correlated with sea-surface temperatures in the Bay of Bengal and with seasonal plankton abundance (a possible environmental reservoir of the cholera pathogen, Vibrio cholerae), winter peaks in disease further
inland are not however, associated with sea-surface temperatures. In many countries cholera transmission is primarily associated with poor sanitation. The effect of sea-surface temperatures in cholera transmission has been most studied in the Bay of Bengal. In sub-Saharan Africa, cholera outbreaks are often associated with flood events and faecal contamination of the water supplies.

Harmful algal blooms (HABs) produce toxins that can cause human diseases, mainly via consumption of contaminated shellfish. Warmer seas may thus contribute to increased cases of human shellfish and reef-fish poisoning (ciguatera) and pole ward expansions of these disease distributions. For example, sea-surface temperatures influence the growth of Gambierdiscus spp., which is associated with reports of ciguatera in French Polynesia. Vibrio parahaemolyticus and Vibrio vulnificus are responsible for nonviral infections related to shellfish consumption in the USA, Japan and South-East Asia. Abundance is dependent on the salinity and temperature of the coastal water. A large outbreak in 2004 due to the consumption of contaminated oysters (V. parahaemolyticus) was linked to atypically high temperatures in Alaskan coastal waters. Another example of the implications that climate change can have for food safety is the methylation of mercury and its subsequent uptake by fish and human beings, as observed in the Faroe Islands.

Drought

The relationship between drought and malnutrition does not need any emphasis. The spatial distribution, intensity and seasonality of meningococcal (epidemic) meningitis appear to be strongly linked to climatic and environmental factors, particularly drought, although the causal mechanism is not clearly understood. Climate plays an important part in the inter-annual variability in transmission, including the timing of the seasonal onset of the disease. The geographical distribution of meningitis has expanded in West Africa in recent years, which may be attributable to environmental change driven by both changes in land use and climate change. Transmission of some mosquito-borne diseases is affected by drought events. During droughts, mosquito activity is reduced and, as a consequence, the population of non-immune persons increases. When the drought breaks, there is a much larger proportion of susceptible hosts to become infected, thus potentially increasing transmission. In other
areas, droughts may favour increases in mosquito populations due to reductions in mosquito predators. Other drought-related factors that may result in a short-term increase in the risk for infectious disease outbreaks include stagnation and contamination of drainage canals and small rivers.

**Forestry, land use and land use changes**

The distribution and emergence of other infectious diseases have been affected by weather and climate variability. ENSO-driven bush fires and drought, as well as land-use and land-cover changes, have caused extensive changes in the habitat of some bat species that are the natural reservoirs for the Nipah virus. The bats were driven to farms to find food (fruits), consequently shedding virus and causing an epidemic in Malaysia and neighbouring countries. Yearly incidences of Nipah virus related death in Bangladesh is now a common phenomenon.

**Food security and safety**

A comparative estimate between 2000 and 2030 shows that malnutrition related deaths, which were about 80 000 in 2000, will increase to 110 000 in 2030 with an increase in DALYs lost from 2.3 to 8.0 million. (In comparison, for diarrhoeal diseases, the estimates are 60 000 deaths in 2030 compared with about 45 000 in 2000, and DALYs lost will be 1.8 million in 2030 compared to 1.6 million in 2000. Deaths from malaria, approximately 20 000 in 2000, will be about 25 000 in 2030 with DALYs loss of around 1.0 million for both the years each.) It is estimated that the impact of climate change on DALYs lost was 1703.5 per million population in the SEA Region and 920.3 in the world on average in the year 2000.

The World Health Report 2002 stated that malnutrition was the largest health effect of climate change globally. This is caused directly due to food shortage and lack of food safety, as global warming creates an environment conducive to bacterial growth. Easier exhaustion of manual labourers in the agricultural field and manufacturing plants will reduce production and thus raise market prices for the relevant products. The economy will spiral further downwards and result in worsening poverty and malnutrition.
Sea level rise

According to the Intergovernmental Panel on Climate Change (IPCC), the Pacific ocean will experience a rise of 0.19–0.58 m by 2100\(^{59,60}\). Land erosion in the coastal areas as well as river banks has assumed colossal proportions in India\(^{18}\). Bangladesh estimates a sea level rise of 0.3–1.5 m by 2050. By 2100, about 30 million people in Bangladesh will be climate migrants due to the sea level rise\(^{19}\). Salinity, water-logging, drainage congestion, disruption in coastal polders, stronger cyclones and tidal surges, bigger floods, more river erosion, and change in coastal morphological dynamics will be experienced in many of the Regional countries\(^{19}\). There will be a 14% increase in the vulnerable zone with more than 1 m inundation depth due to climate change in Bangladesh. Presently, the estimates indicate that 8.06 million inhabitants in coastal Bangladesh are vulnerable to storm surge-related inundation depths of more than 1 m; the number will increase by 68% with population growth by 2050, even without climate change, and by 110% by 2050 in a changing climate in the absence of further adaptation measures\(^{61}\).

A sea-level rise by 1 m would inundate 3.3 million people in Indonesia\(^{62,63}\). Sea level rise in the Maldives would mean the loss of large chunks of land, increased soil salinity and the consequent effect on crops. Coastal erosion will affect tourism and migration\(^{64}\). While sea level rise is not constant spatially, the rise of the ocean in India is currently measured at 1 mm/year on average\(^{63,65}\). The number of people at risk from flooding due to coastal storm surges is projected to increase from the current 75 million to 200 million globally in a modelled scenario of mid-range climate changes, in which a rise in sea level of 40 cm is envisaged by the 2080s\(^{66}\). The intensity of seastorms is also increasing in recent times\(^{67}\).

Human migration and urbanization

Human migration will be the greatest outcome of climate change due to soil erosion; coastal flooding, inland seepage of sea water, drought and agricultural disruption. It is estimated that there will be 200 million forced migrants by 2050 due to climate change\(^{68}\). This will affect the socioeconomic fabric of those who migrate as a consequence. According to the Asian Development Bank (ADB), there were 827 million slum dwellers in 2010 from 777 million in 2005\(^1\). This will increase further as climate
Regional Strategy for Protecting Health from Climate Change

change impacts the coastal belts. Measures taken to alleviate the poor living conditions of the people in the slums should give priority to women for various reasons.

The emergence of infectious diseases is driven by the movement of humans, domestic animals, wildlife populations and agricultural products through travel, trade and translocation. Road proximity affects travel patterns, thereby resulting in continual introduction and reintroduction of new pathogenic strains. New communities are created along roads, and existing communities can rapidly increase in density. These changes in communities often create or are accompanied by inadequate infrastructure, which affects hygiene and sanitation levels and, in turn, the likelihood of transmission of pathogens. Migration due to climate change is a common coping mechanism. Other coping mechanisms include reduced food intake, switching to less preferred food items, distress sale of livestock and valuables, and eating wild food from forests. Unplanned migration creates sudden problems for and pressure on urban utilities, which degrade the lifestyle of the migrants in particular and the affected people in general. Migration to urban areas is apt to result in a regressive lifestyle, poor basic amenities and environment, enhanced disease outcome, social problems, loss of entitlement and poor medical support. Urbanization and rehabilitation due to climate change-driven migration as a result of coastal and highland eco-degradation will aggravate environmental problems in Asian cities, including air pollution (due to industrial pollution and primitive ways of cooking, in addition to transport related causes), water pollution, land pollution due to poor solid waste disposal, and physical and psychological stress due to migration and consequent congestion. Unplanned towns with lack of space and unplanned road communication systems, especially in slums, have an impact on health aggravated by heat waves further complicated by congestion. Frequent flooding and drainage problems, especially in slums lead to absenteeism in school and lack in productive services, which diminish the quality of life.

**Housing**

Poor housing is associated with social and psychological problems, and children’s learning abilities. Overcrowding spreads acute respiratory infections, tuberculosis, meningitis and intestinal parasites. Four or more persons in a room make it almost impossible to protect infants and children
from burns or scalds, and store hazardous household chemicals safely. In urban areas, slum houses are usually on lands without any entitlement, built of flammable materials on lands prone to flooding, or on steep hillsides or in other dangerous sites. Land entitlement and basic amenities need to be available to slum dwellers. These include construction of sanitary latrines, hand tube-wells, paved pathways, drains and streetlights. Houses with damp wall and/or floor, with poor ventilation and lighting and enough air space are associated with mental and physical problems, such as arthritis and also aggravate respiratory diseases, such as, asthma.

**Waste disposal**

Indiscriminate dumping of waste may induce disease vectors including insects and rodents to change their habitats and habits, and scavenge these waste dumps more frequently for food and thereby disseminate pathogens. Dumping of sewage into river and sea water degrade the quality of water not only on the surface but also in underground reservoirs. Estuarine water, especially in South and South-East Asia, has already been found to contain high coliform and trace element counts. These are destroying coral reefs and giving rise to red algal tides, further deteriorating water safety and providing niches for enteric pathogens. Vitiating coastal and estuarine water will have deleterious effects on fish and bird habitation and spawning, resulting in further poverty and malnutrition. Destruction of ecosystems will stir a hornet’s nest and spread vectors and vector-borne diseases. If ecotourism and fishing in estuarine water are affected, income will be reduced.

Conversely, tourism activities such as boating and diving may also damage the ecosystem, in particular, estuarine marine life and corals directly and indirectly, such as through creating underwater sand currents. Areas that may soak up flood water could also be depleted.

**Occupational health**

Changes in climate have implications for occupational health and safety. Heat stress due to high temperature and humidity is an occupational hazard that can lead to death or chronic ill-health from the after-effects of heatstroke. Both outdoor and indoor workers are at risk of heatstroke. The occupations most at risk of heatstroke include construction and agriculture,
forestry and fishing; some of which are treated as informal and thus devoid of arrangement for any specific care. Acclimatization in tropical environments does not eliminate the risk, as evidenced by the occurrence of heatstroke in metal workers and rickshaw pullers in Bangladesh and India. Several of the heatstroke deaths reported in the 2003 and 2006 heat waves in Paris were associated with occupational exposure.

Hot working environments are not just a question of comfort, but a concern for health protection and the ability to perform tasks. Working in hot environments increases the risk of diminished ability to carry out physical tasks, diminishes mental task ability, increases accident risk and, if prolonged, may lead to heat exhaustion or heatstroke. Fall in output in these sectors would affect market price, will cause further pauperization of the workers and malnutrition in them and their children.

**Gender issues**

Reduction in the availability of water and its quality will make fetching of safe water by the womenfolk more tedious and socially uncomforting. Deterioration of air quality will also affect women the most, since they will have to face a double jeopardy while cooking in unhealthy stoves. Rise of poverty will impact them the most, since they are the ones who have to take the brunt, in raising children and taking care of ill and debilitated in the family. Family discord will torment them squarely under an already compromised environment and socioeconomic condition, further complicated by the impacts of climate change, which may end up in their migration and hence change in occupation and living and other life conditions.

**Mental disorders**

There is increasing evidence of the importance of mental disorders as an impact of disasters. Prolonged impairment resulting from common mental disorders (anxiety and depression) may be considerable. Studies in both low- and high-income countries indicate that the mental-health aspect from flood has been studied insufficiently. A systematic review of post-traumatic stress disorder in high-income countries found a small but significant effect following disasters. There is also evidence of medium- to long-term impacts on behavioural disorders in young children.
2. **Strategic actions**

2.1 **Assessment of vulnerability**

*Introduction*

Assessment of vulnerability, which is also, in a way, a measure of adaptability, is necessary for developing plans to protect health from the impacts of climate change. The information required for this planning is as follows:

1. Type, cause and degree/magnitude of present and future, direct and indirect human risks and health outcomes, as a function of vulnerability;
2. Baseline level of health resilience and adaptability of the people, and
3. The effect of the adaptation measures implemented.

The basic areas that need to be looked into for assessing vulnerability/ adaptability are:

- the range of available technological options for adaptation;
- the availability of resources and their distribution across the population;
- the structure, practice and capacity of critical institutions;
- the decision-making authority, practice, skill/efficiency and vision;
- the relation with international partners and across the border;
- the knowledge management skill among different categories of personnel;
- the stock of human capital;
- level of education, information and experience of the people;
the stock of social capital, including the definition of property rights;

- the system’s access to risk-spreading and other social protection processes;

**Temporality of vulnerability assessment**

**Baseline assessment of risk, vulnerability and adaptability**

Assessment of vulnerability and adaptive skills of the people and the health sector, and monitoring the implementation of an adaptation plan are important areas of research in climate change and health. However, the research has to be iterative, as with each cycle or phase of implementation of adaptation measures there will be a change in the vulnerability status as well as changes in the greenhouse gas and warming scenario. The effect of adaptation also needs to be monitored continuously to see how much benefits and co-benefits are accruing from implementation of a given plan, and whether it has some deleterious effects as well. The strength of adaptation may also vary temporally based on the economic and technological development of a nation and a society on the temporality of an event.

The health benefits of investment in other sectors also need to be taken into consideration to enhance investment in those sectors and guard against inadvertent ill effects on health of investment in those sectors.

The scope of the assessment of health vulnerability and vulnerability of the health infrastructure will be determined by: (i) the health problems/diseases to be assessed; (ii) the policy context/presence or absence of policies that support/should support adaptation; (iii) the geographical region, the population selected for assessment and their characteristics; and (iv) the relevant infrastructure and institutional arrangements.

The scope of the assessment needs to be clear first of all, i.e. whether the assessment will determine (i) the additional human health risks due to current climate variability, future risks of vulnerability to climate change due to present conditions or due to climate changes in the foreseeable future; (ii) the political, socioeconomic and technological conditions by
geographical region and population characteristics, which are by nature dynamic; (iii) the current and/or future adaptive skills and practices; and (iv) the non-climatic determinants of health (v) the costs involved in adaptation by areas of adaptation, such as improvement in technology, strengthening of health systems, etc. It is necessary to look into the general and specific objectives and targets of the assessment. For example, will it be done to propose recommendations for identifying and prioritizing policies, programmes and interventions to address current and/or projected health risks? Will it be done (a) to identify the human and financial resources needed; (b) to assess policies and programmes implemented in the health and other sectors; (c) to reduce vulnerability by a given margin in general or in any particular population category or region; and/or (d) to establish an iterative process for monitoring and evaluation of programmes/projects?

The baseline assessment may be led by probing questions such as: (i) What resources do the government/other service providers/society/family/individual have? (ii) Do all government agencies share a common vision and awareness about the impacts of climate change? (iii) Are all government agencies, partners, communities, families and individuals informed about the risk levels? (iv) What are the risks that make people vulnerable? (v) What is the collaboration and coordination arrangement between partners? (vi) What are the present experiences and practices of adaptation? How effective and efficient are they? A more detailed quantitative assessment of vulnerability may include the following steps:

- Specify the health risks to be addressed in the impact assessment, such as malnutrition, diseases or the causes of diseases (such as vector type? vector breeding site? Risk assessment, such as people’s behaviour to avoid getting bitten?).
- Specify what types of exposure will be measured and up to what range/degree/magnitude, such as extreme weather conditions (if so, which one). Will it be, for example, heat waves of up to 45°C or sea storms of type 4 severity?
- Estimate the distribution of the exposed population and why are they exposed (and the degree of exposure). Which populations were exposed? Which ones were the most exposed and which were the least? Where? Why? (A useful approach would be to develop a vulnerability map);
Regional Strategy for Protecting Health from Climate Change

- Estimate the effect/impact of the exposure, such as how many became ill, and how many died;
- What will be the benefit after adaptation, for example, how many cases of injury/drowning will be prevented?
- Select an exposure–response relationship in the population of interest from the scientific literature or available guidance/information, such as what was the effect/impact on different populations and/or demographic groups after exposure? A futuristic scenario may also be drawn of the vulnerability based on the strength of the elements that facilitate resilience, such as, supportive policy, technology, and funds;
- Calculate the fraction of disease(s) attributable to climate change (and the future burden, i.e. how many diseases and how much of the different diseases were/will be due to climate change);
- Calculate the costs that will be incurred later if these cases are not prevented in time and calculate the cost of managing these cases at present. Also calculate how much will be required to address the present and future predicaments;
- Quantify the uncertainty of the estimate, i.e. the degree of surety that these events and effects/impacts may be due to climate change.

Together with a cost–effectiveness analysis, this assessment offers quantifiable evidence to the decision-maker to prioritize interventions. Other areas of vulnerability assessment, such as which are related to water resources/aquifers may also form a part of the overall vulnerability assessment. Similarly, facets such as housing, economy, topography, geography, etc. create a risk of vulnerability, which might, therefore, also be included in an assessment. Other factors that are important for building resilience and adaptability are occupation, socioeconomic status including literacy, demography, social customs, health-seeking behaviour, intersectoral collaboration and community-based institutions, ecology, food security and safety, market behaviour, political decisions and policy, strength of the health systems and prevalent health problems, among others.
Issues that need special consideration are: technical feasibility, awareness and capability to influence the adoption of the options; capability to influence resource allocation; governance and equity; human and social capital (and an understanding of their types and processes); access to risk-spreading mechanisms, such as insurance (and capability to favourably influence institution of the mechanism); managing information such as understanding the causes and problems; public perception (awareness and solutions), among others. These, therefore, should also be part of an assessment.

Elements of the weather are important in an assessment, such as humidity, soil moisture, air dryness, air current speed and direction, sunlight, cloud cover, air quality (suspended particles including carbon in the air which may affect albedo), transportation system, water and land quality and availability, etc. These will have localized effects on the vulnerability of the population of a particular area in a differential manner at different times.

Coping strategies have been part of people’s lives since life first came into existence. The question, though is, whether such traditional strategies are robust enough to cope with the current demands, or whether people need to develop new adaptive mechanisms. To this end, the initial step will need to identify the prime movers in families and societies, and assess how their coping practices are conducive or detrimental to health, and how efforts conducive to health may be strengthened and supported further.

A very important and practical consideration will be to assess the strength of the health sector infrastructure in terms of human resources, resilience of the physical structure, adequacy and appropriateness of logistics, community involvement in managing primary health-care facilities, and effective and efficient functioning of hospitals.

The current health vulnerability may be assessed through some scoring system, known as health vulnerability index. The advantage is—it also takes into account the non-climatic and environmental indicators in the index, i.e. in addition to the disease load it takes into consideration disease risks, such as rain fall amount, vector density, water quality, national control programmes, immunity level of the people, level of literacy, economic condition of the people, their occupation, scope of mobility etc. The index is a relative but not absolute measure of vulnerability and is useful in
comparing between populations or geographical regions, which therefore is a direct measure of degree of population or region based vulnerability.

**Predictive models of climate change for assessment of future risks**

The regional climate change-impact models such as Providing Regional Climates for Impacts Studies (PRECIS) are designed to be used as inputs to models of weather-related events, such as diseases. Additionally, the population distribution with potential of exposure may be obtained by using the Hadley Centre Coupled Model, version 3 (HADCM3), which describes future climates under various scenarios of GHG emissions. More robust and locally usable regional models are also being developed and used. These, models give future measures of warming, but not so much about rain. These, therefore, need to be examined before employing. Recent models however, a coupled atmospheric and oceanic model give better resolution when downscaled for geographical regions. For coastal and small island landmasses, the Health Forecasting Service of the United Kingdom Meteorology Department, which includes the changing risks of heat stress, air pollution, wildfires and extreme climate events such as floods, droughts and storms, may be consulted. It is known to forecast certain health conditions, such as chronic obstructive pulmonary disease (COPD) and seasonal affective disorder (SAD). Since there is increasing evidence that high ozone and high particulate matter accompanying heat waves increase the risk of mortality, hence, future studies and heat stress-management strategies need to assess the effects of air pollutants. There are very many other techniques of predicting future climate, most of which are statistical treatments. Statistical and regional downscaling have been, in fact, advised to be more specific than general circulation models for a given locality. Statistical regressions have been done to predict malaria, dengue, diarrhea, heat and cold stress and some other diseases with variable accuracy. These experiences are worth exploring.

The predictability of occurrence of disease under various environmental conditions is important for assessing future health risks. The potential was explored of using geographical information systems (GIS), remote sensing, surface and sea temperatures, El Niño-Southern Oscillation (ENSO), number of dead birds, among others, as surveillance tools for predicting epidemics, vectors and helminthic infections.
2.2 Adaptation to climate change

Introduction

Adaptive capacity is influenced by technological and management strength practices, as a function of institutional strength in different relevant sectors. It is also influenced by economic, social, political, environmental and cultural factors, and prowess, which create external and internal incentives or barriers to adaptation. A study by the World Bank using econometric models developed by WHO showed that income and disease are inversely related. Climate change adaptation goals have, in fact, to be achieved through the same route that is taken for achieving the overall development goals such as equity, improving food security, provision of safe drinking water, shelter, access to health care and other resources and capitals, and strong infrastructure. Adaptive capacity hinges on wealth/social capital, and education/information. Adaptability, however, does not automatically ensure efficient and effective adaptation. It has been seen that despite the existence of an efficient forecasting model for heat wave, France was caught unprepared during the 2003 heat wave – the worst in the history of the country and in Europe. This led the French Institute for Public Health Surveillance, in close cooperation with Météo-France, to define and alert the public authorities three days earlier that a heat wave may occur, in order for the National Heat Wave Plan (NHWP) to put necessary measures into operation. A web-based climate information decision-support tool has been developed by the German Weather Service (DWD) which provides probabilistic information about any imminent heat situation in the next 0–14 days at the regional level. Similar adaptation techniques will be useful for SEAR countries as well. Climate change-related interventions therefore need (i) to be mainstreamed, (ii) new mechanisms and tools are to be explored, and (iii) necessary measures are to be integrated within and with other sectoral and development programmes.

Health adaptation is multifaceted. It may be innate or acquired. It may be planned proactively, and it may be anticipatory to the risk of a hazard or reactive to the occurrence of a hazard. It may be related to human systems or natural systems. Among the human systems, it may be in the public or the private domain. The same intervention may be planned and implemented a priori or a posteriori, such as incentive for relocation of
housing, industries; change of farming processes by season, timing or cultivars (drought- or saline-resistant plants).

**Measures as per the recommendations of the Earth Summit**

**Strategic direction:** Meeting primary health care-based programme related needs of the people, particularly in rural areas; control of communicable diseases; protecting vulnerable groups on a priority basis; meeting the urban health challenges; and reducing health risks from environmental pollution and hazards and strengthening of monitoring, surveillance and research capacity and activities.

As per the Earth Summit\textsuperscript{102}, the national targets for the health sector need to be universal access to safe drinking water and sanitary measures for excreta disposal, programmes to reduce mortality from acute respiratory tract infections in children, anti-malaria programmes and control programmes for major human parasitic infections including schistosomiasis, trematode and filarial infections.

The other Rio targets that ought to be pursued are: establishment of appropriate and adequate national infrastructures and programmes for preventing environmental injury; conduct of hazard surveillance; establishment of an integrated programme for tackling pollution at the source and at the disposal site, with a focus on abatement actions; and identification and compilation of the necessary statistical information on health effects to support cost–benefit analysis, including environmental health impact assessment for pollution control, and prevention and abatement measures. Particular emphasis as per Agenda 21, Chapter 6, is to be placed on urban and indoor air pollution; water pollution; minimizing risks from pesticides; solid waste disposal; improvement of health conditions in human settlements; protection from ultraviolet radiation; conduct of environmental health impact assessments as a condition for approving the establishment of industrial plants; institution of monitoring and assessment and research.

**Localization of adaptation**

**Strategic direction:** Vulnerability is location - and population characteristic – category-specific and hence an adaptation plan needs to be suitable and
useful to the vulnerable location and population group, based on their background.

Since vulnerability is local and population characteristic-specific, adaptation efforts have to be segmented, as not all persons, even in the same country, region or society, are equally vulnerable. Efforts should target the most vulnerable first, such as those who live in coastal areas, urban slums, on river banks, small islands or in highlands; people who rely on subsistence farming, fishery, animal husbandry; the poor and illiterate; women, children, the elderly; immune-compromised people and those with chronic and debilitating illnesses.

Planning of an adaptation measure needs to build on the existing level of skill, practice and experience of adaptation, and real and impending hazards, risks, exposure and sensitivity, and their degrees. Since these variables would be different in different socioeconomic, geographic, topographic and epidemiologic situations, a rule of thumb cannot and would not be applicable.

Localized information, therefore, will be necessary. This is particularly true when the global circulation models need to be downscaled for a given place.

The fact that some of the adaptations will be a mirror image of mitigation needs to be appreciated.

**Governance and stewardship**

**Regulation and infrastructure development:**

**Strategic direction:** Anthropogenic causes are responsible both for greenhouse gas emission as well as increasing vulnerability of the people due to damage to the ecosystem and developmental activities in general. Regulations are necessary to ensure that ecosystem is preserved and development is green and ecofriendly through use of renewable natural resources, reuse, recycle and reduction of consumption and controlling sources of emission. Wider scale policies, strategies, regulations and funding priorities are expected to protect the vulnerable and the environment. Right to information has to be strengthened. Collaboration with other relevant
sectors and service providers in the private sectors has to be strengthened and coordinated. Some of the legal provisions available in the Member States may need updating and more effective application, in particular for intersectoral collaboration, preservation of ecosystem, greenhouse gas emission and adequate, appropriate targeting, strengthening programme management, involvement of the stakeholders and communication interventions, market regulation to ensuring basic necessities of life, and provision of incentives or its withdrawal. Poverty alleviation has to be linked with health care, education, social inclusion and environmental sustainability. Framing of laws/acts will be necessary for green procurement and green economy.

Mere formulation of laws and regulations in the absence of supportive policies to address poverty and the environment would not deliver the expected results. Any effort to reform and strengthen a sector without linking it to poverty alleviation and environmental aspects will not be sustainable. Other aspects also need to be looked into, such as rural poverty. Alleviation efforts will not be effective unless, for example, there is support for greening infrastructures, such as transportation and electricity. There is also a need to monitor the effect of the efforts made in other sectors. Effective policies and regulations are required to facilitate this multi-sector approach, along with relevant health and environment policies and legislations.

Individuals and organizations in the government have to be identified or established and entrusted with the responsibility for formulating and implementing these policies and regulations. It is necessary that priority issues receive the necessary high-level attention. Government budgets for the environment, health and other sectors need to be adequate to support strengthening of adaptation programmes. Linkages between health and environment policies are important. Stakeholders also need to understand the impacts of climate change on the economy as well as necessity for health relevant adaptation.

Regional Member States have some effective legal frameworks. Laws exist on the protection of forests and wildlife and wild plants. Laws have been enacted on renewable energy, energy efficiency, biofuels and mitigation of emission. Statutory rules dictate the marketing of climate-proof vehicles, mining, housing and industrialization. National councils, inter-ministerial committees, commissions or management units have been
established to formulate, coordinate and implement national policies and strategies, including policies and infrastructure for carbon trading and clean development mechanism, assessments for climate change mitigation and adaptation, technology transfer and financing, and for monitoring and evaluating climate change policies and programmes. Alternate energy sources, efficiency in energy use, land use, forestry, mining, and marine life and bio-preservation have been covered by laws\textsuperscript{103-106}. Laws and regulations for protecting coasts, coastal people and their occupations have been enacted. Many of the countries have a coastal zone regulation and management plan to safeguard coastal lives and resources. Some of the regulations also take care of coastal industries and ports to safeguard coastal occupation and health\textsuperscript{107}. Policies and regulations for the abatement of pollution have been formulated in a few Member States. These will pave the way for agreements, fiscal incentives and other measures. However, as has been stated earlier, existence of laws, acts and regulations are not good enough. Timely application of these regulatory measures is equally important.

Use of public transportation reduces CO\textsubscript{2} emission, thereby helping to reduce the 800 000 annual global deaths from outdoor air pollution\textsuperscript{1}, 2 million annual deaths from traffic accidents and 1.9 million deaths from physical inactivity. Changing the poorest communities’ domestic energy technologies could reduce 1.5 million deaths annually due to indoor air pollution\textsuperscript{108}. Rapid mass transit systems have proved to be efficient modes of transportation. They reduce emission and have co-benefits for health. There are other benefits as well. For example, the Delhi Metro Transit System in India has helped reduce pollution levels in the city by 630 000 tonnes a year and is earning a carbon credit of about (US$ 9.5 million (£6.1 million) annually for last seven years by 2011\textsuperscript{109}. Street designs and transport systems need to ensure current and potential walking and bicycling trails. The phasing out of two-stroke three-wheelers, mandatory use of catalytic diesel particulate filters and installation of solar home systems through various incentives lower the problems of both indoor and outdoor air pollution. Withdrawal of subsidy on fossil fuel and incentives for the use of renewable energy would be welcome measures to reduce emission and benefit health. Support is being provided to the public transport system, rail transportation system and for alternate sources of energy\textsuperscript{110}. A department for responding to disasters has been established in almost all Member States.
Emergency medical services are being redesigned and strengthened. The national plans of Member States prioritize capacity building, promote GHG mitigation activities, support research, increase awareness and public participation, and strengthen international cooperation. Some of the countries in the Region also have a Disaster Management Act. Early warning systems are being revamped and modernized. Early warning systems have been strengthened. Some of the countries in the Region also have a Disaster Management Act. Early warning systems are being revamped and modernized. Early warning systems have been strengthened.

Emphasis has been laid on food security, social protection and health. Water resource development projects have been taken up to protect villagers from devastating floods and increase food grain production. These have resulted in changes in the country’s aquatic ecosystems and fish production. Community-based clean water supply schemes, health and hygiene campaigns, and integrated vector management programmes have been planned in some Member States. The concept of healthy islands and healthy buildings was espoused, along with strengthening the capacity for health-care delivery and dealing with medical emergencies. Prioritisation of promotion of better nutrition, integrated vector management, more research on climate change-related diseases and the like have been planned. Some of the South-East Asia Region countries have started to provide information on the environmental characteristics and energy efficiency of inland produced commodities to consumers, known as eco-labelling, as a tool for controlling emission. Perpetual/sustainable and eco-friendly packaging is also being considered for future marketing.

Food security and safety will be jeopardized due to climate change. Food preparation, food handling, marketing, packaging, distribution and putting food on individual plates all need legal measures and monitoring. Locally produced, fresh and unpackaged food will help in reducing emission.

Monitoring and surveillance of the use and effects of insecticides, fertilizers, medicines and other chemicals in food and drinks will be useful. Regulations however, will have to be formulated and applied in most of the Regional countries in these areas.

As many countries of the Region do not treat waste before discharging into water bodies, local environmental degradation and poisoning of sea and land-based foods and foodgrains have occurred. Existing environmental laws cover marine pollution control, use of pesticides, fishing and
conservation of fishery resources, and shipping etc. Their application however, falls short of expectation. Measures against vitiating the shore line are necessary to control cholera and other gastrointestinal diseases, and fish-borne neurotoxicity. Enforcement mechanisms are however, inadequate due to institutional, strategic and financial constraints. In view of the potential fall in foodgrain production due to global warming and consequent increase in prices of commodities in the market, some new and courageous laws will be required to control market failures. This will result in reduction of distortions in international food and other commodity markets.

In some countries of the Region, a clearance is required from the Ministry of Environment for all projects that would affect the environment and climate. Apart from this Environmental Impact Assessment (EIA), there should also be a regulation that will make clearance from the Ministry of Health to the effect that a proposed project will not affect public health negatively. In fact Health in All Policies (HiAP) should be the approach taken by the governments, since health is the pivot for learning, production and development. Housing and transportation projects may be cited as examples of immediate concern to health.

Adaptation and mitigation measures relevant to climate change need to be considered as a central issue in development, which should be reflected in the way governments allocate budgets for these functions in different sectors. It is imperative that as per the WHO Global Workplan, partnerships are built with other UN organizations and sectors in addition to the ‘within the health sector collaboration’ at the national, regional and international levels, in order to ensure that health protection and health promotion are central to development. Adaptation needs an exchange of effective information. Adaptation also works through adopting cautionary measures, for example, in the case of an impending natural calamity. This information needs to be communicated in an effective and timely manner by the relevant agencies.

Standards are necessary for the transport and energy industries, and housing sector for economizing fuel use and energy efficiency. Investment tax credit, subsidies, cost-sharing for fuel-switching, lowering of taxes, provision of low-interest loans, curbing the advertisement of energy-inefficient products, development of policy and strict adherence to green
procurement in public sector, funding for research and awareness building etc. will be useful.

**Intersectoral and intrasectoral collaboration:**

**Strategic direction:** Relevant sectors need to collaborate, so that there can be health co-benefits from the policies, strategies, programmes and activities of these sectors, such as agriculture, animal husbandry, fishery, forestry, transportation, housing, and energy. Joint planning, implementation and review and monitoring will be useful. In post disaster response period the importance of inter-sector collaboration and participation of the private sector, philanthropists, social workers, and organizations cannot be overemphasized. Functioning and well understood early warning system must be established. Public health staff, private sector health care providers and school teachers and students may be trained on first aid and mass casualty management including triage. Emergency drills should be conducted periodically in disaster prone areas. Training in disaster response including emergency camp management, managing migration and hygienic shelters and coordination between relevant agencies are important management functions. Efficient evacuation, emergency transportation system and regulations on using public and private resources are necessary. Preparation of hazard maps by location and population characteristics will be useful. Vulnerable communities need to be supported technologically and with necessary information. Studies and piloting on availability and quality of food will be useful.

The importance of collaboration between producers and users of weather and climate services cannot be overestimated. This cooperation ensures that relevant environmental information is properly considered and acted upon by the health sector.

Integration of climate information in the monitoring of climate-sensitive diseases is a necessity. Responding to climate change will require integration of adaptation into all aspects of policy development and planning for poverty reduction and provision of equitable services. Taken together, adaptation and mitigation require that societies are informed or are at least capable of knowing their responsibilities, and are practising measures aimed at emission reduction and adaptation. They need to have the technology, information and financial support to adopt these.
Crop cultivation influences vector-breeding and conversely, vector-borne diseases influence agricultural production. On the other hand, rampant agro-pesticide use contributes to the production of resistance in the vectors. Open irrigation emits methane and also breeds vectors. These point towards a scope for organizing training for cultivators on healthy irrigation and insecticide use, insects that cause human diseases from diseases in animals, how to control those, efficiency in irrigation to protect water quality and quantity, reduction in the use of agrochemicals, peridomestic sanitation to prevent breeding in containers, geoengineering such as clearing canals, drainage and filling ditches etc. Similar collaboration with other sectors, such as energy, transportation, forestry, education, housing, public health engineering, among others, is also imperative.

The animal husbandry and fishing sectors need to plan how they will face the impacts of climate change. Integrated cultivation of fish in paddy fields, duckeries and pisciculture in ponds are some measures to achieve this. Studies are required on fish movement, spawning and migration, and how these will affect the fish catch, and what adaptive measures will be required. Besides intersectoral collaboration, intrasectoral collaboration between projects and programmes must also be ensured and enforced, such as vertical child and maternal health programmes and climate change, and surveillance and climate change etc. Some institutional arrangement will be required to coordinate this at the operational level. Interministerial forums need to review the cobenefits that can be derived from such collaboration and create a win–win situation for all. These will be facilitated through promotion and sponsoring of research, joint planning, implementation and reviews, and coordination of activities that act as links between climate and health. For example, an integrated vector and pest surveillance and control programme may be more effective and efficient than either alone; integrated management of water resources by the local government, public health engineering, public health department, water resources management department and agriculture department is apt to be more effective; integrated disease, food, water, drink and nutritional surveillance may be more efficient and cost-effective than each of these in isolation. This mechanism may also ensure financing and costing of projects for co-benefits at the planning and implementation levels.
Participation of officials of the Ministry of Finance is necessary in meetings and conferences on climate change along-with those of the Ministry of Environment, even when the subject seems entirely health-related, in view of their important role in climate change negotiations.

Disaster risk reduction (DRR) is an essential part of adaptation as the first line of defence against the impacts of sudden and extreme climatic events. In any disaster response, triage is important with priority to women, children and bread-earners.

A comprehensive risk reduction culture needs to be central to all efforts. There may be two major components of a comprehensive disaster management model – disaster risk reduction (DRR) and emergency response. DRR has, on the other hand, two elements – defining the risk environment and managing the risk environment. These functions need to be built into the development and planning of all relevant sectors. This implies mainstreaming DRR alongside community-level adaptation for sustainable livelihood development and poverty reduction. Disaster response entails construction and management of shelters; running camps; emergency preparedness and communication; risk reduction; development and operation of early warning systems including collaboration with other relevant sectors for access to forecasts; mass casualty management; and psychological support and emergency feeding. Coordination of these efforts is important. For forecasting, linkages are necessary between biological and environmental data through a network. Countries in the Region could develop hazard maps and natural hazard management policies and plans well before devastation strikes for efficient management of hazards.

The health sector may collaborate with the education sector, relevant autonomous bodies (Red Cross/Crescent Societies), and private and nongovernmental organizations to train up senior school students, teachers and volunteers on disaster risk and event management, including risk communication, evacuation and transportation, triage, first aid and camp management.

Intersectoral collaboration will be useful for: (i) cost-effective approaches to and tools for reducing risks due to disasters and climate change; (ii) sharing experiences in climate-proofing and disaster risk management among stakeholders and investing accordingly; (iii) promoting efficient migration through development of infrastructure and arranging for
healthcare, communication, energy, education, infrastructure and basic amenities for migrants; (iv) ensuring demographic-, gender- and socioeconomic-based equity in adaptation and disaster risk reduction programmes through participatory approaches; (v) instituting air, water and ecosystem governance mechanisms; (vi) formulating policies and practices that involve all public and private stakeholders, including community organizations and community representatives.

International collaboration

**Strategic direction:** International collaboration is needed, in light of the impact of climate change on natural resources, such as sharing of water, controlling cross boundary incidences of disease, sharing technology and fund from developed countries and support for international trade for removing poverty in developing countries.

The regional aspect of many environmental issues is critical for promoting effective solutions. Transboundary resources that span national boundaries, such as shared river basins, migratory species of fauna, habitats, disease, etc. require regional management, as states cannot effectively address some of the issues alone. The regional level thus represents a critical middle ground for negotiations, coordination and cooperation among multiple levels of governance.

There is a need to explore the potential for trade in environmental goods and services, and foreign direct investment (FDI) in such ventures. Technology transfer might require waiving of intellectual property rights and make the General Agreement on Tariffs and Trade (GATT) flexible. Member States need to know more about the UN and other international bodies, multilateral and bilateral agencies, their functions, mandates and covenants that overarch climate change-related developments, decisions and technical support. This will be useful for international negotiations on funding and technology transfer.

The World Bank has suggested that reducing regional trade barriers may increase GDP of Bangladesh and Sri Lanka by 17% and that of India by 15% by 2020\textsuperscript{114}. 
Programme/area based interventions

Measures for mental health

**Strategic direction:** Country capacity for counselling and case management will have to be enhanced. Supportive old values and cultural practices will have to be sponsored and supported at grass-roots level for strengthening social inclusion. Studies are required to associate the impacts of climate change to mental health.

Country capacity for social and psychological counselling needs to be strengthened. Folk festivals, as cultural capital, contribute to social cohesion. These cultural events may be the vehicles for disseminating health messages and for mental well-being. The sufferings of poor people have been remarkably aggravated due to the erosion of these cultural practices. Mental health becomes a formidable problem in the aftermath of natural disasters and migration directly or as an outcome of many interwoven interactions. Risk communication, counselling and case management skills, should be available at the primary health-care level to address these issues.

Measures for nutrition, food safety and security

**Strategic direction:** Resilience and adaptability depend on economic strength of the nation, individuals and families. Support to local economic measures including preservation of ecology and environment, agriculture and fishery and food preparation, marketing and storage will be necessary. Monitoring of pesticides and fertilizers and quality of processed and street-vended food will have to be strengthened. Local production and consumption of commodities will help in reducing price and greenhouse gas emission besides ensuring quality of the commodities.

Seasonal large-scale fruit processing plants in locations where these fruits are produced may be installed to ensure employment for the rural poor. Mango and jackfruit are drought-tolerant crops, which may give good nutritional dividends even when impacted by climate change.

Preservation of the ecosystem is necessary for ensuring continuous availability of sea-based foods. Among food, as fish and chicken are
responsible for the least amount of emission and are also good sources of protein, the consumption of these foods need to be encouraged. Dependence on sea fish would probably have to be reduced and local cultivation of fish encouraged.

Encouragement of locally produced, packaged and consumed foods will help in reducing the price of these commodities as well as in reducing greenhouse gas emission, since less travel and transportation time and ‘food mileage’ will be consumed. The ongoing programmes on nutritional surveillance, public awareness interventions and nutritional surveillance programmes have to be strengthened in the face of the future fall in food commodities and its impact on nutrition of the vulnerable.

**Gender Issues**

**Strategic direction:** Development of adaptation measures should prioritise women, as they are the most vulnerable among the poor, to the impacts of climate change. Assistance provided to them has snowballing effect and therefore more efficient in outcome.

Men and women are affected differently in all phases of a disaster, from exposure to risk and risk perception; to preparedness behaviour and practices, response to warning communications; physical, psychological, social and economic impacts; and ultimately in recovery and reconstruction. Natural disasters have been shown to result in increased domestic violence against, and post-traumatic stress disorders in women. Women’s level of tolerance and aptitude to behave positively in the fact of calamities and their socio-l networks are helpful in recovery. After the 1999 Orissa cyclone, most of the relief efforts in India, were targeted at or given through women, giving them control over resources. Women received relief kits, including house-building grants and loans, resulting in improved self-esteem and social status. Similarly, following a disastrous 1992 flood in Pakistan in the Sargoda district, women were involved in the reconstruction design and were given joint ownership of the homes, promoting their empowerment. The important message is that in matters of adaptation, women should get priority not only because they are the most vulnerable in our societal construct, but assistance to them has every chance to be effective, as it snowballs in benefits to other family members, especially the children and elderly.
Occupational health interventions

Strategic direction: Necessary measures, such as orientation, training and cooler sheds, green corners and adequate amount of water will be necessary as priorities for formal and non-formal workers and their caretakers, in the face of future warming of the working environment.

Since global warming will further deteriorate the working environment both in the formal and in the informal sectors, necessary measures are warranted to protect workers’ health from the impacts of climate change. Firstly, they need to be briefed on the impending situation that the workers are already facing both in the factories and in the agricultural fields. Enough measures need to be arranged for managing cases of heat stress and factory medical officers need to be trained on the physiology and pathology of heat stress and how to manage the heat stress conditions. Enough natural and constructed sheds need to be built for nonformal sector workers, such as farmers. Provision of water for drinking and bathing would be useful.

Measures in the housing sector

Strategic direction: Necessary measures in the housing and city zoning sector are: innovative designs for maximum use of day light, natural cooling, air movement, outdoor cooling, safety within and to natural disasters; using safe housing materials; provision for walking and cycling and efficient transportation arteries; use of energy efficient appliances; proper and economic disposal of waste including use of wastewater for gardening and use of waste for domiciliary level energy generation; city zoning and efficient transportation arteries etc. will help in maintaining health, support service provision to the vulnerable and reducing greenhouse gas emission. Retrofitting of existing houses can be cost-effective in the long run. Research on healthy housing that lessens greenhouse gas emission need to be conducted. Training of health workers on how to take care of home based patients and growing up children will be useful.

Some of the recommendations on housing of the Commission on Health and Environment of WHO\(^\text{32}\), which may be useful in climate change adaptation, are as follows:

- Development of skills and knowledge of health personnel to work with other social services, such as child care for working or
sick parents, shelter for the homeless, care for the disabled, and services to cope with violence, drug and alcohol abuse in home settings

- Development of national strategies to reduce overconsumption and wastage of consumables and commodities at the family level
- Conducting research on the health status of urban populations, successful community health projects, low-cost appropriate housing technologies and alternative methods of waste disposal.

Some other strategic points\textsuperscript{32} for the housing sector are:

- conduct a health impact assessment (HIA) of proposed housing and co-benefits to health;
- ensure that housing strategies, designs and plans include land use and transport planning for walking, cycling and rapid transit/public transport, as well as access to green areas to enhance health and climate benefits, and reduce risks, such as urban heat island effect, ponds or water fountains in courtyards as natural cooling modes, natural ventilation, good thermal conditions and sanitation, neighbourhood densities and design features such as building heights;
- ensure active and passive natural ventilation with appropriate humidification/dehumidification to prevent transmission of airborne infections and enhance reduction of other chronic respiratory problems, with housing screens in malaria-endemic countries;
- institute appropriate standards and codes, and avoid hazardous materials (such as asbestos, radon, lead paint, pressed wood products using formaldehyde binders, volatile organic compounds [VOCs], polychlorinated biphenyls [PCBs] and arsenic in caulk and timber, insulation materials containing formaldehydes, and foamboards containing carcinogens and endocrine disruptors;
- consider the impacts of GHG at all stages of building construction and use;
Regional Strategy for Protecting Health from Climate Change

- design houses that facilitate safety, independent mobility of and free access for children, older adults, women and other vulnerable groups;

- promote greater health equity through (i) “climate-friendly and resilient” housing designs in cities and areas vulnerable to earthquakes, landslides, flooding, fires and other natural hazards (housing should address both adaptation and mitigation), and (ii) climate-adapted shelters to protect against dust, insects and rodents while providing security and insulation against noise.

Retrofitting existing buildings with insulation to improve the thermal envelope can yield significant health gains in terms of reduced illness, hospitalization and days off from work. Energy-efficiency improvements in appliances could yield savings of at least 25%\textsuperscript{115}. A combination of insulation and upgradation of the heating system results in an improvement of 0.56 months of life saved per person\textsuperscript{116}. Window placement can also have an impact on thermal protection and the health effects of extreme heat or cold. The location of bedrooms and the duration of exposure to sunlight can determine risk factors for heat waves. The health impacts of window replacement to protect against winter cold may reduce self-reported symptoms of joint pain, headache, and neck or back pain. Improved insulation, combined with appropriate ventilation, reduces mould and dampness in homes, and health risks due to indoor air pollution from biological contaminants\textsuperscript{117}. There are other features that combine cost, energy efficiency, cooling, lighting, GHG emission, and health and durability aspects\textsuperscript{118-122}. Entitlement to land in urban slums, however, is an impediment that needs to be addressed if MDG 7 is to be attained\textsuperscript{66}.

Anticipatory care measures such as gentle exercise, monitoring and maintaining rooms at the right temperature, and use of light boxes help to keep the individual well and reduce the need to access expensive health care. Experience of these kinds may be explored further for regional adoption\textsuperscript{77-80}.

Management of water resources

Strategic direction: Assessment and monitoring of water quality and quantity will have to be strengthened. Availability of wholesome water in adequate quantity close to human habitation should be a priority. National
policy, regulation and strengthening of programme on water resources management, safety and utilization for different purposes and additional sourcing of water are warranted. Particular attention is to be given to contamination of water from mines, industrial and agricultural products, hospital, street and household waste. Contamination of natural sources of water and household water needs to be controlled.

The UN Committee on Economic, Social and Cultural Rights avows that, “The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights.”

South Africa is one of only a few countries to have expressed recognition of the human right to water in its Constitution. In 1994, the Government established a goal of providing free water, up to 25 litres per person per day by 2008. The percentage of the population with access to basic water has improved under this policy from 60% in 1994 to 86% in 2004.

Some of the measures required to attain water security may be as follows:

- provision of safe wastewater for productive use by separating industrial and domestic waste, and working with farmers to reduce health risks;
- increasing national investment and international aid for investment in water infrastructure, including storage and flood control;
- rainwater harvesting at the individual housing/family level, provided that the safety and wholesomeness of the rain water can be ensured and monitored.

Water resource management should also include actions that will reduce all potential sources and activities which spoil the quality and reduce the availability of water. These include useless and harmful herbs, shrubs, plants and trees which soak up water, increase of the chances of wildfire and whose leaves salinize or acidify water. Attention needs to be paid to control the entry of pesticides; insecticides; toxic metals; carcasses; household, hospital and industrial wastes and medicines into water. Floods, in particular, carry and distribute these materials to far-flung areas. The irrigation system and some other water-based agricultural and mining practices emit methane and CO₂, and also spread organic materials,
chemicals and metals harmful to health. Adequate and appropriate measures, including water quality monitoring measures, need to be taken in this regard.

Management of air quality

**Strategic direction:** Use of biomass as fuel has to be discouraged and improved cooking devices have to be supported. Harmful emission from transportation needs to be controlled through regulation and designing of transportation arteries. Air quality and temperature monitoring capacity need to be strengthened, practiced and people need to be kept informed about any deterioration of air quality and rising temperature, and the impacts of these phenomena on their health and how to manage these predicaments.

In India, through a national programme\textsuperscript{124}, low-emission stove technology is offered to families for burning local biomass fuels. This will not only reduce CO\textsubscript{2} emissions, but will also avert about one-sixth of premature deaths due to acute respiratory tract infections in children younger than 5 years of age, and chronic respiratory and heart disease in adults older than 30 years of age by 2020. Changing methods of electricity generation to reduce CO\textsubscript{2} emission would reduce particulate air pollution and deaths\textsuperscript{126}. A best-case scenario for reducing such pollutants would save an additional 1500 life-years per million people per year in India. In China a similar measure will save an estimated additional 500 life-years per million people per year in China\textsuperscript{124}.

The Canadian Meteorological Service and the US Environmental Protection Agency (EPA) produce a daily air quality forecast. Air quality advisories are issued when the air pollution levels exceed national standards. A cornerstone of this process is the development of relevant and timely health messages. Within a decade, the US EPA is expecting to provide reliable air quality forecast guidance beyond two days at a spatial resolution of 2.5 km\textsuperscript{77}. Transfer of this technology would be useful for SEA Member States.

Control of emission from transports, particularly from diesel engines and burning of raw biomass which releases carbon particles and soot will be some other important measures to reduce air pollution. Designing transportation arteries to reduce travel of the commuters and
encouragement of mass rapid transit system will help in reducing air pollution, reduce greenhouse gas and carbon and lead particulate matter emission and improve health (additionally, as people might walk up to the stations for availing a rapid mass transit system).

**Waste management and sanitation**

**Strategic direction:** Monitoring and controlling of industrial wastes and harms therefrom; orientation and training of policy personnel, health and sanitation professionals, industrial and hospital management and workers, agricultural personnel and farmers, school teachers and students; more efficient disposal, recycling and reduction of consumption which create volumes of wastes; reduction of the volume of wastes at the level of disposal; use of wastes for generating energy; reuse of wastes; and implementation of international multi-lateral environmental agreements are to be given importance to.

The WHO Commission on Health and Environment stressed on a healthy work environment and waste management through the following means:

- Apply technology in existing plants to protect the health of workers;
- Increased attention to monitoring the release of industrial discharges, and quantifying the health and environmental effects of the discharges;
- Take up educational and training activities for policy-level personnel, healthcare professionals, workers and managers of the health sector, department of agriculture and farmers; workers on safety and environmental sanitation including waste management; management in industries and hospitals; for journalists and others in the media; the public and especially schoolchildren, to increase their understanding of environmental problems from wastes; and orientate experts to train and give advice to other groups.

Recycling of waste water in urban areas is now in practice globally for domestic purposes, irrigation and waste treatment, but is not a common practice yet in this part of the world. Waste is now used at an increasing rate for generating energy and fuel gas. These measures also have the co-
benefit of reducing the emission of GHG. Funding and technical support have been sought by different countries and regions for carrying out these activities. Management of persistent organic pollutants is also important in this regard\textsuperscript{127}. Movement of hazardous waste across borders, controlled by the Basel Convention\textsuperscript{128}, is an issue for health; which may become formidable in the light of climate change.

The amount and type of waste generated from health facilities is staggering. At the family level, measures have been adopted in many societies and homes to manage waste efficiently instead of indiscriminate dumping, such as collecting organic and inorganic wastes separately and disposing of these efficiently, including composting from organic waste and using it in kitchen gardens, and reusing bath and kitchen waste water for gardening.

Strict measures are necessary for controlling indiscriminate dumping of wastes into the sea, river, lake and pond. In the countries of the Region monitoring of the disposal of industrial waste is of particular importance. Public-private partnership in disposing off domestic and community wastes has shown promising results in some of the Member countries of the South-East Asia Region.

**Preservation of ecdiversity**

**Strategic direction:** Preservation of ecosystem and its diversity; and its regeneration and strengthening of relevant protective programmes have to be undertaken. Activities that harm coastal zones including recreational and industrial ventures and fishery must be monitored and regulated.

Maintenance of ecdiversity is necessary to preserve genetically stronger cultivars, birds, fish and animals in their natural habitats. The source of medicine for many, living in the forest fringes and in tribal belts, is the naturally available herbs and shrubs, preservation of which, therefore, is important for them.

Sufficient legislation has been promulgated in the countries of the Region on preserving the ecosystem, including flora and fauna and water bodies. However, their application is weak, and needs strengthening. Necessary laws are however, required for preservation of species of useful flora and controlling harmful ones.
Coral reefs are a barrier to seastorms, as are coastal mangrove forests and hills. Offshore oil drilling, maritime trade and recreational activities, such as boating, diving and surfing, damage the coastal ecosystem. These, therefore, need to be licensed under strict conditions. Reconstruction, seawalling, levy, mangrove afforestation and beach nourishment are warranted.

**Measures for migrants, urbanization and population growth**

**Strategic direction:** A standing plan to manage migration should be developed. Migrants need to be supported with healthy environment, housing and other necessary life and social support, including education for children. Decent jobs, human rights and dignity including right to choose, social inclusion and preservation of cultural norms and practices need to be supported.

A standing plan for migration, based on the nature and degree of the cause and effect, will have to be available in operationalizable form at a very short notice. Migration should be planned such that the basic amenities of life are ensured to them in the migrated habitat. Since migration destabilizes the disease situation, it is necessary that any community created due to migration is under surveillance for some time for the emergence of diseases in migrant populated areas, and the necessary infrastructure is put in place to deal with any eventuality with built-in follow-up measures as a component of any planned migration. Intracountry migration usually ends up in further spread of existing city with resultant social problems besides the economic problems. Rehabilitation measures and measures for schooling, medical care and other basic needs of the migrant population, including water, sanitation and electricity need to be monitored in the light of the fact that migrants are often refused from getting these basic services.

Consumption is the driving force behind emission. The bigger the population, the more the consumption, and need for amenities. All of these will further increase GHG emission. As a means of adaptation and reduction of vulnerability, the fundamental measure would be to limit the rate of population growth and provide basic amenities to the people, in line with MDG 7.
Measures for hospital safety

**Strategic direction:** Physical design and construction of hospitals should be disaster proof. Health-care facilities need to be assessed and monitored for safety when faced with disasters. Hospital design should be conducive to manage mass casualty situations.

The Mexico earthquake in 1975 has shown that hospital infrastructure and services may be jeopardized as a result of climate change. Resilient building materials and climate-proof hospitals are of utmost importance. The physical structures should be able to withstand the onslaught of extreme weather conditions and seismic effects, equipment should be functional, continuity of communication (telephone and emergency transportation), electricity, water and sanitation should be ensured during disasters, and service providers need to be available to provide services even in the face of threats to security. Hospital preparedness in emergencies (HOPE)\(^{129}\) and emergency drills are important for keeping the health system updated and ready to face extreme weather conditions efficiently and effectively. Schoolchildren, teachers and community representatives may be trained to protect themselves and manage the after effects of natural calamities at large. Capacity to assess damage to hospitals should also be inculcated.

Public health and other emergency measures

**Strategic direction:** Strengthening of health systems, in particular primary health care is the most fundamental action to be taken to face the health impact of climate change. Skilled human resources in management, in clinical areas for treating climate sensitive health problems and in counselling and risk communication; strengthen preventive and control programmes; adequate easily manageable fund and logistics; efficient personnel, financial and logistical management are necessary for assessing and adapting to the health impacts of climate change. People need to be made aware of the sources of greenhouse gas emission, reduce emission and how to manage the various health impacts of climate change. Disease, vector and risk surveillance is a priority to notice a rise in the climate-sensitive disease, so that effective control measures may be taken timely and efficiently, and people may be issued with advisories. Vulnerability may be reduced by taking a priori measures, such as vaccination, emphasizing on creating
enough shed and seeking of health care by the people at the nick of time. Sanitation and hygienic measures need to be adequate. Research and knowledge management capacity to understand climate change impacts and on adaptation to the impacts of climate change on health; collaboration between health and other relevant sectors for forecasting calamities; and integrated surveillance for risk and health outcome and early warning system need strengthening.

The most important and foremost health response to the impacts of climate change should be strengthening the health system to respond to the present and additional burden of the climate sensitive diseases. Many of the health risks and outcomes associated with climate change are already being addressed through low-cost, high-impact interventions such as immunization, micronutrients for children and women, deworming, behavioural change for adequate infant- and young child-feeding and care practices, and constructing hospitals that are friendly to the elderly, physically challenged, women, adolescents and children.

Sanitary and hygienic measures such as hand-washing with soap can reduce the incidence of diarrhoea by 45%, and that of acute respiratory diseases by 23%\textsuperscript{130}. Of the about 13 million deaths/year globally, 4 million could be prevented by improving water, sanitation, and indoor and outdoor air pollution\textsuperscript{33}.

Institutional capacity is required for managing cases of heat stress. Usually, in the countries of the SEA Region, there is no early warning system in place for a heat wave. This could be improvized using the print and mass media, such as television and radio as well as cellular telephone services, all of which have an extensive reach. Not only can warnings about the impending heat wave be conveyed, but clear instructions and advice can be provided to those who are susceptible. A medically useful definition of heat wave is also necessary. Close collaboration between the meteorology department, municipal corporations and local health departments is required for planning and preventing heat stress, as well as providing prompt first aid and referral, if necessary.

Impoverishment, change in occupation and habitation, including migration to an unfamiliar environment due to the impacts of climate change, will cause psychosocial stress resulting in depression. This may lead to misuse of alcohol, domestic violence, and other dramatic and negative
behavioural changes. These may also place affected people in further danger of exposure to diseases that they might not be immune to. Adequate safeguards to protect them from these health and mental predicament need to be planned. Strong community networks can act as a buffer against the psychosocial effects of poor physical environments. Action to improve psychosocial health often combines improved social services and employment opportunities. In brief, the health sector and health adaptive measures may be based on the following:

- develop awareness-raising and learning materials to educate and engage a broad range of stakeholders, including the media, religious leaders, youths and the policy-makers;
- integrate surveillance for early warning of heat waves, other impending weather extremes including the effect of forest fires on health; vector density and bionomics; food, water and air quality; endemic and infectious disease outbreaks, and malnutrition for early case detection, treatment and referral, which would help to contain the spread of diseases;
- conduct surveillance of new pathogens and other dynamics of pathogenicity and vector capacity. These include virulence, multiplication and maturation time of pathogens and vectors, flight, feeding practices, longevity, and capacity of transmission of vectors and pathogens;
- develop skills to predict future disease potential under different emission scenarios and possible warming;
- develop standard operating procedures for climate-sensitive diseases including surveillance for risk factors, vector bionomics and pathogens, and clinical management, if these are not already available, and ensure that these are used when available;
- establish cross country collaborative arrangements for disease control and disaster response;
- develop and monitor risk indicators (such as endemicity rate, mosquito numbers, aeroallergen concentrations);
- develop the capacity to issue seasonal forecasts of extreme weather conditions such as drought, rain and flood, snowfall,
hailstorm, land- and sea-based storms and surges, water level rise, erosion, landslide, bursting of dams, and pestilence;

- strengthen and ensure effective and efficient utilization of early warning systems;
- inculcate capacity to manage national and international donations during disasters;
- strengthen effective and efficient disaster response mechanisms including evacuation, transportation and management of shelters and camps;
- enhance skills to manage natural hazards and mass casualties;
- monitor outside air temperature, humidity level and rain, especially in hot summer days in collaboration with the meteorology department and issue cautionary note if necessary including how to manage cases of different types of heat stress and near drowning;
- monitor indoor and outdoor air quality and sensitise people to avoid deteriorated environment. Also advise people on how to avoid deteriorating air quality including the use of improved cooking devices and avoiding biomass;
- strengthen quality assessment system for water and air, Improve environmental quality, i.e. quality of air and water, and waste management;
- enhance people’s knowledge on the ill effects of ultraviolet (UV) rays and how to avoid UV rays;
- strengthen infectious and non-communicable disease control programmes including adequate treatment facilities;
- improve the capacity of health facilities to treat climate-sensitive diseases and other health services, such as complications of pregnancy, geriatric problems, malnutrition, injury, near-drowning, poisoning, snakebites, and prevent disease transmission in field camps;
- strengthen referral systems and the health system’s capacity to prevent, control and manage diseases;
Regional Strategy for Protecting Health from Climate Change

- arrange for appropriate workforce training and retention, including the capacity for logistics management, technology transfer and absorption, and programme and personnel management capacity;
- develop skills for risk communication, counselling and undertaking psychological measures where needed;
- develop vaccines and institute vaccination programmes ensuring wide coverage and acceptance socially and religiously;
- strengthen community-based neighbourhood support/watch schemes and other empowering measures;
- develop the capacity for and undertake studies on the health implications of climate change and share information to promote changes that mitigate health risks in individual and corporate behaviours, while protecting and promoting health;
- monitor risk behaviour, water and air quality, food safety, nutritional status of children, pregnant and lactating women, the effects of chemicals (fertilizers, pesticides, medicines) in the environment.
- strengthen the capacity to assess health vulnerability;
- strengthen supervisory, monitoring and evaluation functions for adaptation projects in particular;
- develop a database and network, and facilitate national working groups, NGOs, civil society and experts to develop coordinated mitigation and adaptation plans, including research and capacity building to reduce climate-sensitive risk factors and adverse health outcomes;
- develop and maintain a database of past and current research projects related to climate change;
- take measures to improve data quality and upgrade existing data; and coordinate the dissemination of research findings within the scientific community, and to policy-makers and the community.
- strengthen partnerships between scientists, policy-makers, local government leaders and NGOs;
Regional Strategy for Protecting Health from Climate Change

- develop an adaptation plan for the health sector based on national and international evidence;

- involve the community and other stakeholders including the relevant sectors and service providers in joint planning, implementation and monitoring and evaluation with the aim of strengthening community resilience and enhancing co-benefits from other sectors;

- establish effective climate response units capable of international negotiation on funds and technology transfer, within-country research and knowledge management capacity, and programme planning and implementation;

- identify and map vulnerable populations and their locations by their degree and cause of vulnerability, and prioritize adaptive measures accordingly, based on their present experience of vulnerability and adaptation to those;

- enhance skills to manage international support either in emergency situations or in slowly evolving cases of health problems;

- ensure eco-environment-user-friendly and disaster-proof designing of hospitals and facilitate utilization of hospital services;

- establish functioning and effective intersector and collaboration for deriving health benefits from the policies, plans and programmes of other relevant sectors; and participate in intersectoral joint planning, implementation, review and monitoring in relevant areas;

- formulate policies, strategies, programmes, and regulations for health co-benefits and facilitating health sector response to disasters in collaboration with other relevant sectors;

- plan and implement advocacy strategies and activities to raise community knowledge for improving resilience and mitigating emission, including the use of renewable energy, mitigation at the family and corporate levels, facilitation of intra-stakeholder collaboration and coordination, and policy and programme support;
Regional Strategy for Protecting Health from Climate Change

- choose alternate energy sources and more fuel-efficient machines, electricity consumption and transports at homes, in hospitals and offices;
- wastes being injurious to health as well as a source of greenhouse gas emission, arrange waste disposal from all sources (home, hospital, and industry) following all safety measures and in a manner that reduces the possibility of greenhouse gas emission, and recycle waste for gardening, or generating energy;
- build awareness to reduce consumption, recycle waste and reuse wastes and commodities (such as destruction of useless and harmful trees, plants and shrubs which soak up water, and replacing them with economically and environmentally useful ones among lay people, corporate bosses and public sector policy-makers;
- advocate for ecosystem preservation and strengthening among lay people, corporate bosses and policy-makers;
- advocate for building ecofriendly/green and climate-proof “cooler” urban layouts and physical facilities, and ensure the safety of the physical structure of health facilities;
- create conducive working environment in factories and production units;
- measure carbon footprint of health facilities regularly and take measures to reduce it;
- support overall national economic and technological development;

Capacity building of health systems

Communication

**Strategic direction:** Communication interventions in schools would be an effective approach for mitigation of greenhouse gas emission as well as strengthening adaptation and resilience. Public and private sector managers, opinion leader and celebrities may be oriented so that they are active partners in communication. Communication materials should be developed based on need assessment. Communication interventions should also prioritize the vulnerable. Messages will have to be developed based on past or present trial and error and experience.
Communication and training are crucial in mitigating emission, and in adapting to changes in the climate. Communication interventions in schools are effective approaches for which teachers would need materials and training to educate the children. It is necessary to involve the private sector in preparedness and vulnerability reduction by forming public–private partnerships. Conducive institutional and management arrangements are necessary to ensure that the public and private sector are involved in reducing and responding to climate change. To garner support, it is necessary to brief formal and informal opinion-makers, such as religious leaders, socially respected philanthropists, and elected leaders including celebrities, and orient and use them for communication.

National communication strategies development and planning need to be based on a thorough needs assessment. The thrust of communication would be to make people and their leaders proactive and let them understand how their acts may increase or reduce emission, resilience and adaptability. They should also be educated on how to adapt to the health impacts of climate change, how to avoid injuries and the economic implications of climate change. Communication programmes must aim to enable and empower the people, in particular, the illiterate, poor and other vulnerable people such as women, children, the elderly, people suffering from debilitating medical problems and those living in coastal areas, highlands and urban slums. Such programmes should have adequate and appropriately designed communication tools that are locally suitable, popular and comprehensible.

To mount a communication intervention, it is necessary to know the target audience, what messages and processes may influence them, and what types of media outreach would be efficient and cost-effective. It is important to understand what the media wants in a story, and make sure that the information is provided to them in a clear and timely manner. News releases should be succinct and include the five Ws: who is involved; what happened; when it happened; where it happened; and why or how it happened or what may happen – how, why, where, among whom and how to face it.

Training

**Strategic direction:** Training will have to be competency based; one aim of which would be to develop and strengthen leadership and technical skill for professionals in relevant areas.
Training of health staff needs to be provided according to their functions and competency. Building leadership skills is required for managers, policy-makers, planners and other decision-makers in the health sector. Technical skill is required for other interventions, such as surveillance of food safety, risks and risk behaviour (including the use of insecticides and other chemicals), malnutrition, vectors and disease. Technical skill is also needed in the areas of case management (including of malnutrition); first aid; disaster management; risk communication; entomology; epidemiology; meteorology; monitoring and evaluation; research; planning and management.

Training on climate modelling and risk assessment skills would be technologically dense but necessary.

**Strategic direction:** Strengthening of health systems, especially primary health care would be a priority and would involve physical structure and management of services with adequate human resources, logistics and inventory management. Standard operating procedures for managing climate sensitive diseases need to be in place.

Primary health-care systems have to be strengthened with the involvement of the community in its management and maintenance. The physical infrastructure to withstand the onslaught of climate change, and to be effective enough to support people in their fight against the impacts of climate change. Availability of adequate human resources is a pre-requisite.

Hospital services need to be capable of attending to emergency and referral cases adequately and efficiently. Availability of adequate and appropriate logistics are necessary. Up-to-date inventory management, efficient storage systems, transportation and distribution of logistics are crucial for ensuring effective logistics management.

Adaptation and mitigation in the health sector would require technology transfer from Kyoto Annex II countries as per the covenant of the UNFCCC (Article 4 of the UNFCCC)\textsuperscript{131}.

A standardized list of logistics by tier including medicines, kits, equipment, machines and human resources by skill and gender mix may be prepared for addressing the different types and degrees of impacts. These
resources will be necessary both for diagnosis and surveillance of diseases and malnutrition, and for monitoring and evaluation of adaptation and mitigation measures.

Specific strategies and standard operating procedures for managing climate sensitive diseases should be reviewed in light of the future impacts of climate change with prevention and control in mind.

Taking care of the adverse effects of adaptation

**Strategic direction:** Monitor and review the adaptation measures planned and implemented. Some measures may backfire or go astray; while some developmental and adaptive measures in fact can multiply the climate-sensitive health problems or other economic and social problems.

Adaptation measures may be self-defeating if their aftermath is not considered. For example, reclaiming coral reef flats causes loss of fish resources forever. The reclamation of a sandy lagoon, however, has less environmental and economic effects. Dredging, fishing, boating, diving, eco-tourism, other coastal recreation and harbour construction activities also cause sedimentation and turbidity of water that can kill coral and change the composition and size of fish species.\(^\text{132}\)

Gem mining in Sri Lanka leads to stream bank erosion, and abandoned gem pits provide breeding grounds for mosquitoes. Cattle ranchers send their herds illegally into wildlife parks and compete with wild elephants for food, as a result of which elephants are forced to stray into farmlands seeking corn and sugarcane. Human and elephant deaths ensue. Far from the main road in forested, sparsely populated areas, people grow cannabis illegally, destroying the green cover and thus reducing the size of the carbon sink. Illegal timber harvesting is widespread, despite strong law enforcement by the forest departments in many countries.\(^\text{133}\)

The Aral Sea Basin in Central Asia was the world’s fourth-largest freshwater sea. From the early 1960s, water was diverted from its two sources, the Amu Darya and the Syr Darya rivers, in order to supply the vast cotton fields to the south of the Aral. Chemical pollution from excessive use of fertilizers and pesticides has left the population living in that area with severe health problems. Ten per cent of children die within the first year of
life; deaths from chronic gastritis and kidney disease have increased by 15%; the incidence of heart disease has doubled and that of cancer has increased tenfold; death from TB is 21 times higher than it was in the 1960s. Fishing, which once thrived, can no longer provide livelihoods. This perhaps is an example of how an ill-understood adaptation measure may nullify the very strength of adaptation.

Not all projects or interventions produce the expected or similar results. Nepal’s mitigation programme, for example, has increased poverty in major trekking routes, since animal husbandry in these areas has dwindled as the social forestry department bars shepherds from grazing animals along these treks. People affected by the construction of the Delhi metro system were rehabilitated in places far away from the city, which caused hardship to them in terms of commuting time and money, and took them further away from other amenities including health-care services.

2.3 Mitigation of greenhouse gas emission

Introduction

Co-benefits from reduction in GHG emission can offset a substantial fraction of the need for and cost of adaptation, providing possible benefits in the area of energy security and reduced resource use. A strong cap on GHG emissions would bring major and lasting global health improvement, in addition to reducing the global disease burden by more than 25%.

Collaboration with other sectors such as forestry, agriculture, transportation, energy, housing, industry and water resources management is necessary to reduce emission.

Measurement of the carbon footprint in the health sector

Methods described elsewhere may be used to measure the carbon footprint in health-care facilities.
Health sector measures for greenhouse gas emission

Strategic direction: Hospital machines and ambulance fleets may be made more fuel-efficient and green by using hybrid or electric motors in ambulance. Measures may be taken to green hospital surroundings, using kitchen wastes in producing energy, recycling of waste water, designing energy-efficient hospitals or retrofitting measures to improve energy efficiency, installing and procuring energy efficient equipment and machines. Monitoring of GHG emission in health sector ought to be carried out as well. Public awareness by emphasizing the reuse, recycle and reduce strategy would be useful to reduce greenhouse gas emission at domiciliary and corporate level. Alternate/ renewable energy sources may be opted for domestic chores and corporate use including in hospitals. Kitchen wastes may be recycled and so also wastewater from bathrooms.

Greening and landscaping of fallow land in the vicinity of health facilities would make the environment of these health facilities soothing, friendly and healthier, and will also gain carbon credit. Equipping health facilities with energy-saving and energy-efficient tools will help the health sector in mitigating GHG emission and selling carbon credit. Retrofitting of machines, equipment and physical facilities may be one of the avenues for technology transfer or from funds received as per the UNFCCC modalities.

Communication materials on mitigation of emission at the family and corporate levels are available. The health sector could use these materials to enhance awareness of the people to help in mitigating emission. One area of importance will be to do away with the traditional chulhas and replace these with improved cook stoves to reduce the emission of black carbon, carbon monoxide, soot and particulate matter. The health sector also needs to create pressure through an intersectoral approach to prevent the use of fossil fuel in transport and advocate for mass transit systems in the health and other sectors.

Buildings account for at least 36%–40% of energy use in most countries. In air-conditioned offices, however, buildings are responsible for 50%–55% of emission. In the European Union, 40% of GHG is emitted from buildings, more than the 30% from industry and transport (12% from passenger cars). Thus, buildings are a promising area for improving energy efficiency. Retrofitting can save about 20%–30% of energy, and energy needs may be reduced by 20%–30% if strict building
codes are applied and green designing followed\textsuperscript{124, 141-143}. Maximizing daylight but minimizing heat gain from glass in buildings has a substantial saving potential. Substantial amounts of carbon emissions may be avoided through household utilities, rainwater harvesting and house water recycling. Thirty per cent of vegetable needs may be met by cultivation of roof-top and other gardens, which also reduces the food mileage. Composting from kitchen waste may help in kitchen gardening. An earth-tunnel ventilation and nocturnal hybrid cooling system may save 70% of the need for an air conditioner\textsuperscript{117}. These and such similar ventures are worth exploring.

**Selecting green sources of energy**

Oxnard, a California-based company, expects to save 30%–40% of electricity that the company uses per year and cut its annual GHG emission by 30 000 tons per annum by generating electricity from the onion waste that it produces. This is expected to power 460 homes\textsuperscript{144}. This experience may be adapted in large hospitals.

Among the renewable energy sources, wind, biomass, storm, biogas, geothermal, water current and photovoltaic cells are the least expensive; wind source being the cheapest and then in that order (by 2050)\textsuperscript{145}, although solar photovoltaic cells and the micro-hydro system are leading technologies that supply renewable energy in developing countries at present\textsuperscript{146}. Wind energy may prove to be expensive if the instalments are land-based, but may, in fact, be the cheapest if a country has a vast swathe of shoreline. The cost of photovoltaic (P-V) cells may fall precipitously, if the demand, production and supply situation improve. The P-V system however, needs renewing of the device after every twenty years on average and will be less efficient in rainy or cloudy environment. Enough energy can be supplied for the total number of present and future vehicles in the health department through direct conversion of the sun’s energy to electricity and from nuclear power plants\textsuperscript{147}. Conversion of vehicular engines that use fossil fuels to those that use compressed nitrogen gas may be a stopgap measure. Funds may be sought for clean and renewable energy sources in the health sector.

Caution is warranted to ensure that mitigation efforts are not economically counter-productive. Plantations for biofuels (maize and sugar cane) may reduce the availability of foodgrain to the poor directly and
through a higher market price of food grains. Incentives/grants may be pursued for (i) biofuels that do not incur tax on food, such as from sugarcane waste, (ii) social forestry and cultivation of algae for biodiesels.

2.4 Research, monitoring and evaluation

**Strategic direction:** Research knowledge management capacity needs to be increased for assessing present as well as future health vulnerability to climate change and on how to adapt to the health impacts of climate change. Development of hazard maps, indicators and capacity for monitoring and reviewing implementation of adaption is also necessary. Creation of data centres including surveillance reports for dissemination of information to the policy-makers and general public is necessary. A roster of experts on climate change and health and on health research will be useful.

Monitoring, evaluation (M&E) and review are necessary to ensure that implementation follows the plan correctly and that the intended results are obtained. In order to derive and facilitate co-benefits, it would be advisable to conduct the M&E function jointly with all the relevant stakeholders. M&E will also have to assess the adverse effects on health of adaptation plans that are implemented by different sectors and by the health sector itself.

It will be useful to establish data centres to gather and disseminate information related to climate and health within the country and the Region. Appropriate and adequate indicators need to be jointly developed for the M&E function by the relevant stakeholders. A list may be seen in the logframe (See Annex 1).

It will be useful to create national and sector-wise GHG inventories in accordance with Article 12 of the UNFCCC. Continuous reporting is warranted on implementation of the Convention, and an inventory of GHG by sources and removal by sinks, where the health sector may also play some role.

A surveillance database has to be created to assess the prevalence of climate-sensitive diseases with endemic and epidemic potential epidemiological trends. Creating local hazard maps, people’s vulnerability status and the causes will lead to continuous monitoring of changes in these
statuses. These are also necessary for developing area-based adaptation plans.

Maintenance of a list/roster of experts and other relevant organizations and individuals will be useful and handy for procuring their support at minimum notice for knowledge management and information generation, and for seeking their support for M&E, surveillance and research.

Implementation of an adaptation plan may go wrong or may yield negative results. Adaptation plans for climate change by other sectors may create problems for the health sector and the health of the population. Operations research is needed to guide implementers and in taking timely decisions for managing adaptation measures, in light of monitoring, review and evaluation of implementation of plans.

Research capacity is also necessary for predicting future vulnerability. Climatic and statistical models are available for prediction. Training of relevant staff on these techniques and provision of necessary paraphernalia will be required.

2.5 Financing for adaptation

Costing and financing

Every US$ 1 invested in pre-disaster risk management in developing countries would prevent losses of US$ 7^{150}. A simple step, such as the development of community-based infrastructure for water harvesting, can reduce vulnerability and empower people to cope with climate-related risks.

The Stern Report^{151} estimates that “if we don’t act, the overall costs and risks of climate change will be equivalent to losing at least five percent of the global gross domestic product (GDP) each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20 per cent of GDP or more. There is a concern that some developed countries think that no new financial resources are to be provided; only existing commitments for the MDGs are to be met and existing multilateral assistance for development may be diverted through ‘mainstreaming’ climate change actions.” Professor Stern, however, suggests
that, at least in part, the economic cost of abatement should be shifted to developing countries. This attitude demolishes however, the principle of "common but differentiated responsibility" of the UNFCCC conferences.

Efforts to address climate change adaptation and mitigation should not take resources away from the core development needs and growth objectives of developing countries. Economic development is a necessary ingredient towards capacity building against the impacts of climate change. In fact climate change mitigation and poverty reduction should be addressed simultaneously. Likewise, many needed technologies, such as in the case of biomass use, are not yet available in developing countries. Collaborative research and development between developing and developed countries and the relevant institutions is necessary to address this gap.

The World Bank estimated that for the prevention and treatment of diarrhoea and malaria alone, the health sector would require US$ 1.3–1.6 billion per year at 2005 rates over the period 2010–2050 (above and beyond the prevention and treatment of these diseases in a scenario without climate change). South Asia would require US$ 12.6 billion (of a total of US$ 89.5 billion globally) to US$ 15.5 billion (of a total of US$ 76.8 billion) per year between 2010 and 2050. Out of the total global requirement, the health sector would require from 1.6% (according to other estimates) to 5% as per the UNFCCC at 2005 prices.

Contrary to the World Bank estimate, a UNFCCC estimate states that by 2030, US$ 5 billion (US$ 4–12 billion) per year will be needed for treating malaria, diarrhoea and malnutrition, and an additional US$ 11 billion per year for water supply and infrastructure. This is over and above the US$ 22 billion needed by 2015 to improve maternal, newborn and child health, and the US$ 40 billion to enhance human resource capacity to meet MDG 4 in the lowest income countries. Another estimate by Elbi in this regard, has been given below in Table 2 (estimates in million dollars).

Table 2. Projected costs to manage additional climate change-related cases of diarrhoeal diseases, malnutrition and malaria in 2030

<table>
<thead>
<tr>
<th>Emission</th>
<th>Diarrhoeal diseases</th>
<th>Malnourishment</th>
<th>Malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The World Bank study does not include estimates of the costs of many other infectious diseases and conditions that are known to be climate sensitive, such as dengue and other viral and rickettsial diseases, heat or cold stress, population displacement and air pollution. The World Bank recognizes that the estimated adaptation costs would be higher if investments in the water infrastructure sector, agriculture (related to malnutrition) and natural disasters (with health outcomes) were added. Similarly, Elbi also recognizes that adaptation in other sectors is probably more important for reducing the health impacts of climate change (through disaster mitigation, food and water security, and providing decent infrastructure). In terms of investments, it has been estimated that a cumulative investment of US$ 223 billion would be required between 2010 and 2015 in order to achieve the MDG of eradicating extreme poverty and hunger by 2015. Another US$ 477 billion between 2016 and 2030 is estimated to ensure universal access to electricity by 2030.

### Issues for aid negotiation

For negotiating with donors within the country, it is imperative to have intersectoral understanding and consensus, alliance within and with other regions supporting adaptation measures, push for grant-based financing for adaptation, advocacy for equitable allocation, push for direct access to funds, and support for response capacity and technology transfer. In-country capacity to assess vulnerability/adaptability is also important to impress development partners that the funds sought are for genuine purposes. The countries of the South-East Asia Region need to liaise with the Subsidiary Bodies for Scientific, Technical and Technological Advice, and Implementation of the UNFCCC. The resolutions and recommendations adopted in different Conferences of Parties, in particular those held in Buenos Aires, Marrakesh, Bali and Nairobi need to be studied, along with the UN Conferences held in 1972, 1992, 2002 and...
2012. In addition, the reports of the Durban Platform for Action and the Ad-hoc Working Group on further Information about the commitments for Annex I countries and also required for better informed negotiations and decisions. For international negotiation and funding, Member States must exhibit strong proof that climate change is high on their agenda\(^{42}\) and that there is effective coordination between aid agencies and the national government in addressing climate change activities. Domestic capacity to respond to the needs of donor agencies is also an important requisite. Priority needs to be given to capacity building in planning and managing implementation, with adequacy of resources in human, logistics and technology.

As may be of interest that, only half of the first 2010–2012 tranche of global/UNFCCC funding refers to adaptation. This adaptation fund is for the least developed countries, small island developing states and Africa; but only in the context of meaningful mitigation actions and transparency in implementation. The other catch in this funding is that it has to come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance. There is no clarity on whether there would be any conditionality on co-financing and, if so, what will be their ratios\(^{159}\). Mitigation of emission in the developing world needs to consider that: (i) it has no adverse impact on GDP growth, poverty alleviation, health and health sector financing, and burden of diseases in developing countries; (ii) there is binding commitment by developed countries to research and development, diffusion and deployment of cost-effective clean technologies in every sector of developing countries that require the additional funding, with emphasis on health, energy and agriculture; and (iii) there will be a permissible trend of rising carbon emission up to 2050 in developing countries, such as carbon credits of up to 35 million tons to India and 182 million tons to China/year.
3. References


(4) Islam A. Climate change and health: challenges for the health system in Bangladesh. Dhaka: James P Grant School of Public Health, BRAC University, 2009.


Regional Strategy for Protecting Health from Climate Change


World Health Organization Regional Office for Europe. Improving public health responses to extreme weather/heat-


Regional Strategy for Protecting Health from Climate Change


(111) Phoolcharoen W, Nantaworkarn B. Healthy policy foundation, Thailand. HIA of the climate change to Thailand’s health system and its development: report prepared by HSD Unit. New Delhi: WHO-SEARO.


### Annex

**Logframe of the Regional Strategy to Protect Health from Climate Change**

#### Output 1: Establishment of an effective organization at Member State level and SEARO

**Expected result 1: Health sector has an effective institutional basis to protect health from climate change**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Verifiable indicators</th>
<th>Source of verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establishment of an office with (i) focal point, (ii) terms of reference, (iii) technical/advisory/expert committees/working groups, (iv) skilled staff, (v) funds</td>
<td>Focal point’s office functioning effectively</td>
<td>Programme report</td>
</tr>
</tbody>
</table>

#### Expected result 2: Climate Change Unit in the country and at SEARO are managing knowledge effectively

<table>
<thead>
<tr>
<th>Activities</th>
<th>Verifiable indicators</th>
<th>Source of verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Establishment of research/knowledge management unit in the office for climate change and health</td>
<td>Effective exchange of information and experiences between different levels, sectors, countries and regions</td>
<td>Programme report</td>
</tr>
<tr>
<td>3. Establishment of data base and list of experts</td>
<td>Utilisation of the experts</td>
<td>Programme report</td>
</tr>
<tr>
<td>4. Development of tools to assess and monitor vulnerability and adaptation skills, and their periodic updating</td>
<td>Availability of the tools</td>
<td>Assessment tool</td>
</tr>
<tr>
<td>5. Development of capacity to predict future risks, climate change scenarios and impacts</td>
<td>Predicted future climate scenario</td>
<td>Study report</td>
</tr>
</tbody>
</table>
### Output 2: Functioning of an effective and efficient management system

#### Expected result 1: Member States have effective policy, strategic direction, plans

<table>
<thead>
<tr>
<th>11. Development of capacity for intersectoral leadership and global negotiating capacity (of health sector professionals, managers and policy-makers)</th>
<th>Amount of international financial support obtained</th>
<th>Programme report</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Development and enactment of effective and relevant policies, regulations, strategies and plans</td>
<td>Effectiveness of the regulations</td>
<td>Programme evaluation</td>
</tr>
</tbody>
</table>
### Expected result 2: Greater management efficiency and effectiveness have been attained through collaboration

<table>
<thead>
<tr>
<th>Expected result 2</th>
<th>1. Demonstrable derivation of co-benefits</th>
<th>Programme evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. (i) Establishment of an intersectoral collaborative mechanism for deriving co-benefits; (ii) links between biological and environmental risk and impact data</td>
<td>2. Collaboration between the health and meteorology departments</td>
<td></td>
</tr>
<tr>
<td>14. Establishment of regional centres of excellence and collaborating centres</td>
<td>Utility of support from the regional centres</td>
<td>Programme evaluation</td>
</tr>
<tr>
<td>15. Effective and efficient transfer of technology including measurement of the carbon footprint of health facilities and capacity to predict future vulnerabilities</td>
<td>Utiliability of transferred technology</td>
<td>Programme evaluation</td>
</tr>
<tr>
<td>16. Continuously conducting monitoring and supervisory visits and review meetings, including surveillance for diseases and policies, plans and practices of other sectors</td>
<td>Use of intersectoral monitoring reports in decision-making</td>
<td>Programme report</td>
</tr>
<tr>
<td>18. (i) Establishment of an effective early warning system</td>
<td>(i) Early management of outbreaks</td>
<td>Programme evaluation</td>
</tr>
<tr>
<td></td>
<td>(ii) Timely movement to shelter</td>
<td></td>
</tr>
<tr>
<td>(ii) Establishment and functioning of a disaster preparedness and response system</td>
<td>(i) Conduction of multi-sector drills</td>
<td>Programme evaluation</td>
</tr>
<tr>
<td></td>
<td>(ii) Effectiveness of rescue operations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(iii) Efficiency of mass casualty management capacity</td>
<td></td>
</tr>
</tbody>
</table>
19. Strengthening of health facilities and health systems
   (i) Disaster proofing of the health facilities
   (ii) Capacity to manage climate sensitive health outcomes

**Programme evaluation**

<table>
<thead>
<tr>
<th>Output 3: Health sector and the people adapt to the health impacts of climate change and mitigate greenhouse gases efficiently</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected result 1: Increased awareness of the health consequences of climate change among all</strong></td>
</tr>
<tr>
<td>20. Advocacy to the public, policy-makers, managers, other sectors and donors for adequate resources and functional support</td>
</tr>
<tr>
<td>1. Percentage of national budget allocated</td>
</tr>
<tr>
<td>2. Value of co-benefits attained</td>
</tr>
<tr>
<td>1. Earmarked funds from annual budget</td>
</tr>
<tr>
<td>2. Programme evaluation</td>
</tr>
</tbody>
</table>

| 21. (i) Awareness building of the people, public leaders, managers in health and other sectors for efficient adaptation and mitigation in domestic, corporate and health-care settings, (ii) provision of training and logistics |
| 1. Percentage of households practicing mitigation and adaptation measures |
| 2. Percentage of health facilities practicing mitigation and adaptation measures |
| Programme evaluation |

| 22. Inclusion of climate change, health and nutrition related topics in institutional curricula at different levels |
| Knowledge of students on the impacts of climate change on health and nutrition |
| Programme evaluation |

**Expected result 2: Better management of the health consequences of climate change and mitigation of greenhouse gas emission**

| 23. Implementation of adaptation plans |
| Prevalence rates of most common climate sensitive diseases |
| Programme evaluation |
24. (i) Undertaking of greening efforts in the health sector, including green public procurement and energy source
(ii) Periodic assessment of the carbon footprint of the health facilities

<table>
<thead>
<tr>
<th>Measurement of the carbon footprint of selected hospitals</th>
<th>Programme evaluation</th>
</tr>
</thead>
</table>

**Output 4: Effective reporting of programme implementation**

**Expected result 1: Timely and complete reports are available on the progress and effects/impacts of the activities**

<table>
<thead>
<tr>
<th>25. Submission of progress reports to the Executive Board (EB) and World Health Assembly based on EB RC 5 and WHA 61.19 (global workplan)</th>
<th>Percentage of required reports submitted in a timely and complete manner</th>
<th>Submitted report</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Submission/transmission of in-country/Regional reports to relevant authorities and organizations</td>
<td>Percentage of required reports submitted in a timely and complete manner</td>
<td>Submitted report</td>
</tr>
</tbody>
</table>

89
This Regional Strategy for Protecting Health from Climate Change has been developed to fulfil the decisions taken at the twenty-fifth, twenty-sixth and twenty-seventh Meetings of Ministers of Health of the Member States of the South-East Asia Region held in Thimphu, Bhutan in 2007; in New Delhi, India in 2008, and in Kathmandu, Nepal in 2009. These meetings urged WHO to formulate a regional strategy to combat the adverse health impacts of climate change. WHO was also requested to provide technical support for applied research, facilitate knowledge-sharing between Member States, assist in resource mobilization and facilitate regional coordination to voice common concerns at the United Nations Framework Convention on Climate Change (UNFCCC). In addition, the Regional Committee in 2009 (SEA/RC62/R2) urged the WHO Regional Office for South-East Asia to develop a strategy for funding health-related climate action plans. This document is expected to assist Member States in developing, strengthening and updating their national strategies and plans of action on climate change and health.