

# **REGIONAL STRATEGY** for Protecting Health from Climate Change



**World Health  
Organization**

Regional Office for South-East Asia



# REGIONAL STRATEGY for Protecting Health from Climate Change

*Environmental Health &  
Climate Change Unit*

*Sustainable Development &  
Healthy Environment Department*

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# CONTENTS

ACKNOWLEDGEMENTS	iv
ABBREVIATIONS	vi
PREFACE	viii
I. BACKGROUND	1
1.1 Introduction	1
1.2 Effects and impacts of climate change on health	3
1.3 WHO activities in protecting health from climate change	12
II. OBJECTIVES AND OUTCOMES	17
2.1 General objective	17
2.2 Specific objectives	17
2.3 Expected outcomes	17
2.4 Indicators	18
III. STRATEGIC ACTIONS	19
3.1 Assessment of vulnerability	19
3.2 Adaptation to climate change	25
3.3 Mitigation of greenhouse gas emission	48
3.4 Research, review, monitoring and evaluation	50
IV. FINANCING AND PLANNING	54
4.1 Costing and financing for adaptation	54
4.2 Issues for aid negotiation	56
V. REFERENCES	58
VI ANNEX: Logframe to protect health from climate change	74

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## Abbreviations

ADB	Asian Development Bank
CO2	carbon dioxide
COP	Conference of Parties
COPD	chronic obstructive pulmonary disease
DALY	disability-adjusted life year
DG	Director General
DRR	disaster risk reduction
DWD	German Weather Service
EB	Executive Board (of WHO)
ENSO	El Niño Southern Oscillation (current direction and the sea water temperature in the Pacific)
FDI	foreign direct investment
EPA	Environmental Protection Agency (of the USA)
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GHG	greenhouse gases
GIS	geographical information systems
GLOF	glacial lake outburst flood
HADCM3	Hadley Centre of the UK Met Dept (version 3 of the climate forecasting tool)
HIA	health impact assessment
HOPE	hospital preparedness in emergencies
IASC	Inter-Agency Standing Committee of UN for inter-agency coordination of humanitarian assistance
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goal

M&E	monitoring and evaluation
NGO	nongovernmental organization
NHWP	National Heat Wave Plan (of France)
NOAA	National Oceanic and Atmospheric Administration, USA
PCB	polychlorinated biphenyl
PRECIS	Providing REgional Climates for Impacts Studies
R&D	research and development
RC/R	Regional Committee/ Resolution
SAD	seasonal affective disorder
SEA	South-East Asia
SEAR	South-East Asia Region
SEARO	Regional Office for South-East Asia (of WHO)
TB	tuberculosis
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
VOC	volatile organic compounds
WHA	World Health Assembly
WHO	World Health Organization



## Preface

This Regional Strategy for Protecting Health from Climate Change incorporates the decisions taken at the Twenty-fifth Meeting of Ministers of Health at Thimphu, Bhutan, in 2007. This meeting called upon WHO to "support the formulation of a Regional Strategy to Combat the Adverse Health Impacts of Climate Change". In addition, the SEA/RC62/R2 (2009) resolution urged the World Health Organization's Regional Office for South-East Asia to develop a strategy to fund health-related climate change action plans.

Member States have their own national strategies on climate change and health as well as national adaptation plans of action for seeking funds from the Global Environmental Facility. This document, however, aims to assist Member States in further strengthening and/or updating their national strategies on climate change and health, and their national plans on protecting health from climate change, with adequate focus on the health sector and intersectoral collaboration for deriving collateral benefits for health.

For a long time, health has not occupied the place it deserves in national and global dialogues, plans and negotiations. This document will help to put health at the centre of development, along with other tools, in light of the impacts of climate change on health, and in line with other compelling areas.

I take pleasure in congratulating the Environmental Health and Climate Change Unit of WHO-SEARO in particular, and the Department of Sustainable Development and Healthy Environments in general, for developing this much-needed document. I am sure that it will fulfil the requirements of Member States of the Region in the relevant areas.

Dr Samlee Plianbangchang  
RD, SEARO



## 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.....".<sup>1</sup>

Climate and weather extremes are manifested also through food insecurity, social disruption and population displacement, and favour the spread of communicable diseases.<sup>2</sup> Climate change may be responsible for hazards as diverse as heat waves and cold spells, smog and wildfires, and other events.<sup>3</sup>

In the 1990s, on an average, major natural catastrophes alone caused economic losses of US\$ 66 billion a year at 2002 prices,<sup>4</sup> 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).<sup>5</sup> Loss of income from tourism in Sri Lanka and the Maldives will jeopardize their present rate of development, and will also affect the attainment of their health goals. Mental disorders may be the consequence of economic loss and/or bereavement.<sup>6</sup>

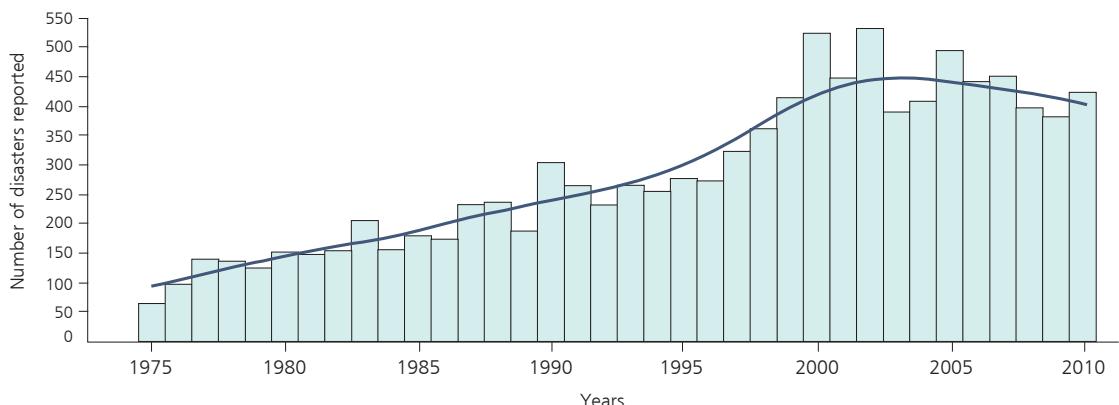
Economic losses may in fact be more devastating than can be understood. For example, one third of the Sri Lanka's population, 24% of the land area, more than 80% of fish production, rich mineral resources, tourism and 80% of industries are situated in the coastal regions of Sri Lanka. Coastal contribution to the gross domestic product (GDP) increased gradually to 40% by 1989.<sup>7</sup>

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.<sup>8</sup>

Changing precipitation patterns, rising annual mean temperatures and melting glaciers will cause a serious survival problem for about 1.5 billion South Asians.<sup>9</sup> Out of the 16 most climate-vulnerable countries globally, 10 are in Asia.<sup>10</sup>

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.<sup>11</sup> These will have implications on global developmental support provided to developing countries by developed countries.

Figure 1. Number of natural disasters worldwide between 1975 and 2010<sup>12</sup>



Global warming will increase the prevalent endemic diseases both spatially 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.

**Table 1.****Agents and infectious diseases with suspected or known links to landscape change<sup>13</sup>**

<b>Vector-borne and/or zoonotic</b>	<b>Soil</b>	<b>Water</b>	<b>Human</b>	<b>Other</b>
Malaria	Melioidosis	Schistosomiasis	Asthma	Haemorrhagic fever
Dengue	Anthrax	Cholera	TB	
Lyme disease	Hookworm	Shigellosis	Influenza	Foot and mouth disease
Yellow fever	Coccidioidomycosis	Rotavirus		Rice blast
Rift Valley fever		Salmonellosis		Trachoma
Japanese encephalitis		Leptospirosis		
Onchocerciasis		Cryptosporidiosis		
Trypanosomiasis				
Plague				
Filariasis				
Meningitis				
Rabies				
Leishmaniasis				
Kyasanur Forest fever				
Hantavirus				
Nipah virus				

## 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<sup>14</sup> and Nepal.<sup>15</sup> Continuing glacier retreat in some areas and intensification of monsoon rains elsewhere will create variability in river flow in the highlands of the subcontinent.<sup>9</sup> 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,

they will damage crops leading to malnutrition and further poverty. Drought can also increase respiratory diseases due to dust storms. Floods and coastal storms cause migration, occupational change, 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.<sup>16</sup> High temperatures and poor urban air quality could contribute to widespread heat stress and smog-induced illnesses in urban populations,<sup>17</sup> besides a fall in agro outputs.<sup>17–22</sup> 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.<sup>23</sup>



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.<sup>24</sup>

## Slowly evolving conditions

### 1. From environmental 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.<sup>25</sup> Waterborne diseases, such as diarrhoeal diseases, are also influenced by El Niño.<sup>26–28</sup> Correlation has been found between annual rainfall, the number of rainy days, and the incidence of malaria.<sup>29</sup>

Twenty-four per cent of the global disease burden and 23% of all deaths can be attributed to environmental factors.<sup>30</sup> Children less than 5 years of age bear more than 40% of this burden.<sup>31</sup> 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%.<sup>32</sup> Poor water and sanitation also have socioeconomic implications, e.g. 443 million school days each year are lost from water-related illnesses, which lead to poverty in adulthood.<sup>33</sup>

Waterborne diseases account for 60 million DALYs lost each year or 4% of the global total DALYs.<sup>33</sup> According to WHO,<sup>34</sup> 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 immunizable diseases account for 70% of the deaths among children aged 0–4 years.<sup>35</sup>

Foodborne diseases account for an estimated 76 million episodes of illness, 325 000 hospitalizations and 5200 deaths in the USA alone per year.<sup>36</sup> 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,<sup>37</sup> while two thousand million people in total are at risk for waterborne and foodborne diarrhoeal diseases.<sup>37</sup> The burden of diarrhoea and malnutrition attributable to climate change is the highest, both globally and in South-East Asia.

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.<sup>38</sup> 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 the estimated 2.3 million deaths due to respiratory infections in the SEA Region, close to 750 000 (33%) were due to air pollution.<sup>39</sup> Better enforcement and further improvement of air pollution standards would lower the levels of certain fine particulate matter and could bring down these deaths by 15% a year.<sup>39</sup> Of the 15 cities in the world with the highest levels of particulate matter, 12 are in Asia.<sup>40</sup> 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.<sup>41</sup> 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.<sup>41</sup>

Over a million people die each year from malaria.<sup>37</sup> Vectors breeding in water transmit malaria (267 million infected), filariasis (90 million infected), onchocerciasis (18 million infected) and dengue fever (30–60 million infected every year).<sup>30,33,42</sup>

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,<sup>38</sup> and children under five years of age constitute 85% of those who die as a result of climate change.<sup>38,43</sup> 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.<sup>44</sup> Drought can also increase or decrease vector efficiency and related diseases within a short time span, followed by a decrease in the long run.<sup>45</sup>

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

Altered rainfall patterns and storms 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 in the Maldives.<sup>48</sup> 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, e.g. 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. Rise in temperature and humidity in some places may decrease the incubation period of *Plasmodium*, and increase the biting frequency, transmission potential and survival of *Anopheles*.<sup>49</sup> Other diseases have already started to rise in number, e.g. salmonellosis in Australia, while the bluetongue virus (animal virus) and *Schistosoma japonicum* in China show a northward expansion.<sup>50</sup>

It is estimated that 95% of the global dengue burden is attributable to climate change.<sup>30</sup> 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.<sup>17</sup> 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 1986–88 in the

His Hseng township of Myanmar, about 3012 feet above sea level; but since 2005, dengue has become endemic there. Taungzi township, which is 4912 feet above sea level, had a similar experience (personal communication on 12/5/2010 with Dr Win Kyaw, Director, Public Health, Ministry of Health, Government of the Union of Myanmar). Bhutan and Nepal are reporting cases of dengue for the first time since 2006. Mosquitoes transmitting dengue were prevalent at a height of 500m above sea level but are now sighted at an altitude of 2200m in Darjeeling, India, and 4000m 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 SEAR 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.<sup>46,47</sup> Bangladesh has been reporting deaths due to Nipah virus encephalitis among the rural population since the past decade.<sup>48</sup>

Deaths are predicted to increase from noncommunicable diseases also such as heat stroke, cardiovascular diseases, melanoma and other malignant neoplasms of the skin, and other diseases of the skin and subcutaneous tissue. Ultraviolet rays cause sunburn, photoageing of the skin, reactivation of herpes of the lip, and cataracts and pterygium.<sup>48,51</sup> Meningitis<sup>52</sup> and food poisoning<sup>53</sup> have also been related to climate change. There has also been an increase in the incidence of asthma, allergic rhinitis and bronchitis due to increase in air pollutants, allergens and ground-level ozone, fanned by soil fungi, moulds and microorganisms.<sup>51</sup>

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 and low birth-weight babies, exposure to radioisotopes with consequent effects such as birth defects, gynaecological cancers, changes in the onset of puberty, anaemia, kidney diseases, etc.<sup>54</sup>

## 2. From 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 of 1.8 million in 2030 compared with 1.6 million in 2000. Deaths from malaria, approximately 20 000 in 2000, will be about 25 000 in 2030 with DALYs lost remaining around 1.0 million for both the years.) 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.<sup>30,38,55</sup>

The *World Health Report 2002*<sup>38</sup> 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 products. The economy will spiral further downwards and result in worsening poverty and malnutrition.

## 3. From 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.<sup>56,57</sup> Land erosion in the coastal areas as well as river banks has assumed colossal proportions in India.<sup>18</sup> 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.<sup>19</sup> Salinity, water-logging, drainage congestion, disruption in coastal polders, strong cyclones and tidal surges, bigger floods and more river erosion, and change in coastal morphological dynamics will be experienced in many of the Regional countries.<sup>19</sup> 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.<sup>58</sup>

A sea-level rise by 1 m would inundate 3.3 million people in Indonesia.<sup>59,60</sup> 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.<sup>61</sup> While sea level rise is not constant spatially, the rise of the ocean in India is currently measured at 1 mm/year on average.<sup>60,62</sup> 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.<sup>63</sup> The intensity of sea storms is also increasing in recent times.<sup>64</sup>

#### **4. Human migration and urbanization**

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 situation, social problems 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 the use of inefficient and polluting sources of energy by traffic and, to a lesser extent, industrial pollution, in addition to primitive ways of cooking), water pollution, land pollution due to poor solid waste disposal, and physical and psychological stress due to congestion.

Unplanned towns with lack of space and unplanned road communication systems, especially in slums, have an impact on health due to congestion aggravated by heat waves. Frequent flooding and drainage problems lead to absenteeism in school and lack of productive services, and hence lower productivity and diminish the quality of life.<sup>65</sup>

## **5. Other health implications of sea water**

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; (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.<sup>66</sup> These will be aggravated by the increasing warmth and acidity of the sea water.

The acidity of oceans has increased by 30%<sup>67</sup> and warming is increasing by 0.1°C per year.<sup>68</sup> 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.<sup>41</sup> Food and nutrition may thus be under 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. 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.<sup>5</sup> All these dynamics will affect migration.

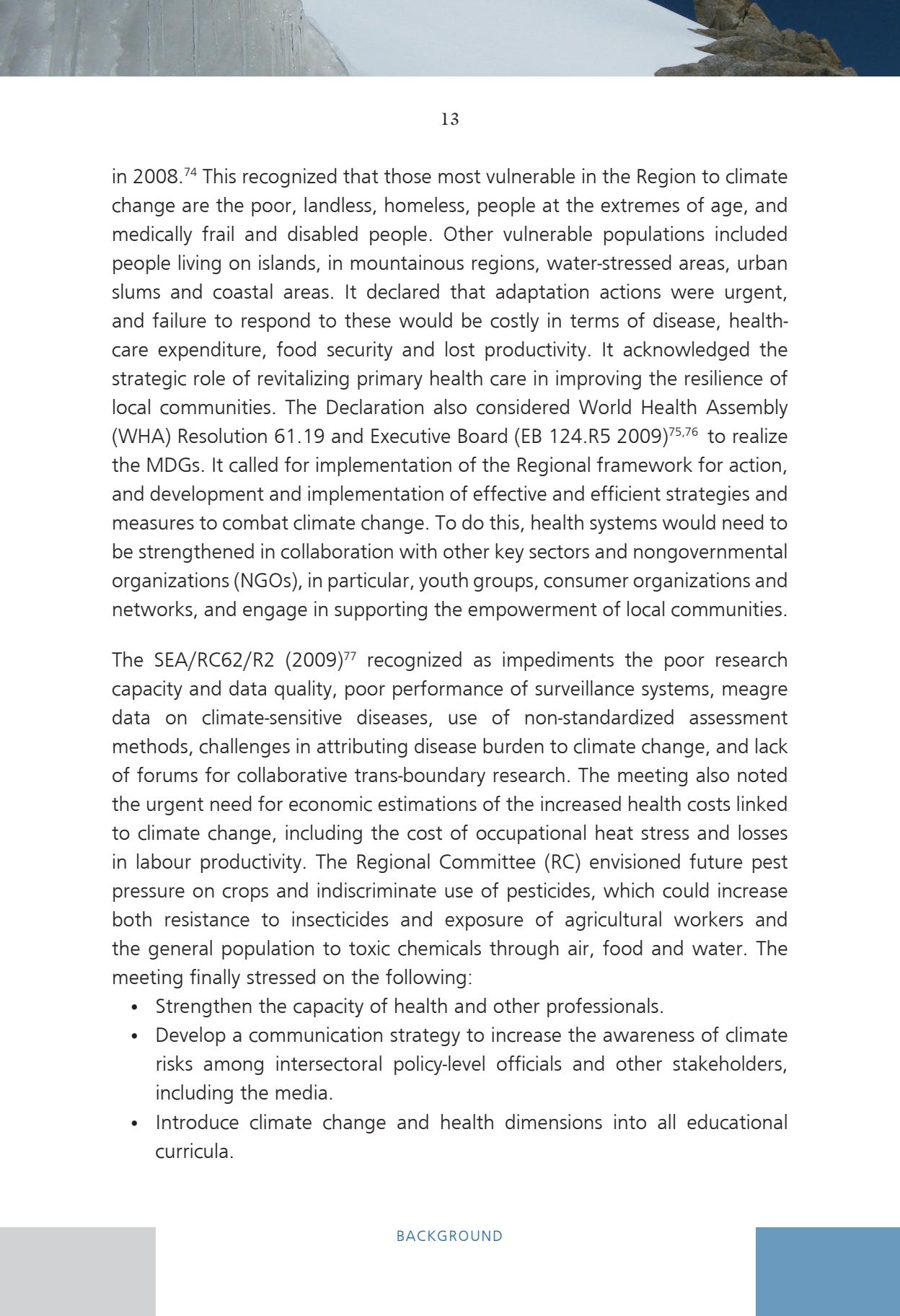
## 1.3 Activities undertaken by WHO to protect health from climate change

WHO, in collaboration with other partners, deliberated on the urgent needs of small island states<sup>63</sup> and highlands.<sup>69</sup> The WHO bi-Regional Workshop on Climate Change and Health<sup>70</sup> developed a Regional response to reduce the burden of disease from climate change, with emphasis on strengthening the capacity for assessment and research on climate-sensitive health risks. A Regional framework for action was developed in Bali in 2007<sup>71</sup> with three objectives: (i) increasing awareness of the health consequences of climate change among political, financial and community leaders, health practitioners, nongovernmental and other sectors, and the general public; (ii) strengthening the capacity of health systems to provide protection from climate-related risks, and substantially reduce health systems' greenhouse gas (GHG) emissions; and (iii) ensuring that health concerns are addressed in decisions to reduce the risks from climate change by other key sectors.

At the 25th Meeting of Ministers of Health in Thimphu, Bhutan in 2007,<sup>72</sup> climate change was considered as a major threat to health security. The meeting called upon WHO to "support the formulation of a Regional strategy to combat the adverse health impacts of climate change". The Thimphu meeting urged WHO 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). The meeting called upon Member States to develop and support policies to reduce GHG, conduct pilot projects on adaptation, enact laws and strengthen legal mechanisms.

WHO and the Confederation of Indian Industry developed a *Healthy Workplace in Corporate Sector India* and identified 10 industries ranging from manufacturing, construction, cement and pharmaceuticals, etc. with high potential for emission.<sup>73</sup>

The 26th SEAR Health Ministers Meeting adopted the New Delhi Declaration



in 2008.<sup>74</sup> This recognized that those most vulnerable in the Region to climate change are the poor, landless, homeless, people at the extremes of age, and medically frail and disabled people. Other vulnerable populations included people living on islands, in mountainous regions, water-stressed areas, urban slums and coastal areas. It declared that adaptation actions were urgent, and failure to respond to these would be costly in terms of disease, health-care expenditure, food security and lost productivity. It acknowledged the strategic role of revitalizing primary health care in improving the resilience of local communities. The Declaration also considered World Health Assembly (WHA) Resolution 61.19 and Executive Board (EB 124.R5 2009)<sup>75,76</sup> to realize the MDGs. It called for implementation of the Regional framework for action, and development and implementation of effective and efficient strategies and measures to combat climate change. To do this, health systems would need to be strengthened in collaboration with other key sectors and nongovernmental organizations (NGOs), in particular, youth groups, consumer organizations and networks, and engage in supporting the empowerment of local communities.

The SEA/RC62/R2 (2009)<sup>77</sup> recognized as impediments the poor research capacity and data quality, poor performance of surveillance systems, meagre data on climate-sensitive diseases, use of non-standardized assessment methods, challenges in attributing disease burden to climate change, and lack of forums for collaborative trans-boundary research. The meeting also noted the urgent need for economic estimations of the increased health costs linked to climate change, including the cost of occupational heat stress and losses in labour productivity. The Regional Committee (RC) envisioned future pest pressure on crops and indiscriminate use of pesticides, which could increase both resistance to insecticides and exposure of agricultural workers and the general population to toxic chemicals through air, food and water. The meeting finally stressed on the following:

- Strengthen the capacity of health and other professionals.
- Develop a communication strategy to increase the awareness of climate risks among intersectoral policy-level officials and other stakeholders, including the media.
- Introduce climate change and health dimensions into all educational curricula.

- Map the available resources (including human resources).
- Identify ongoing programmes.
- (i) Identify national research institutions, networks and partnerships available and necessary to conduct studies, using a standardized research methodology; (ii) ensure that research findings/results are used to support the development and use of tools and methodologies to assess vulnerability; (iii) identify existing WHO collaborating centres that could undertake research and shortlist institutions that could become new WHO collaborating centres; (iv) strengthen Regional networking and cooperation to exchange and share the evidence base; (v) procure data and information on climate-sensitive diseases and health problems, and on best coping practices through existing mechanisms such as the Inter-Agency Standing Committee (IASC) Task Force on Climate Change; and (vi) facilitate synergy and collaboration between health scientists and practitioners and meteorologists.
- Strengthen surveillance for the determinants and outcomes of health problems in endemic, epidemic, pandemic and emergency situations for strengthening early warning systems.
- Prepare and implement a plan to reduce the carbon footprint of the health sector.
- Develop a strategy to fund health-related climate change action plans.
- Mainstream climate change-related health issues into the health sector agenda.

The WHO Regional Office for South-East Asia (SEARO) facilitated a national consultation on research to assess the impact of climate change on communicable diseases.<sup>78</sup> This led to the development of a generic research protocol for retrospective and prospective studies. Funds were provided for research and national workshops.

In 2010, SEARO convened a meeting of Parliamentarians in Thimphu, Bhutan<sup>79</sup> to discuss regulatory matters with regard to the health impacts of climate change. A meeting of high-level government officials of Member States of the Region was organized in Dhaka in 2010 to orient them to the Conference of Parties (COP) 16.<sup>80</sup>

At the 63rd WHA in 2007, WHO emphasized the key preventive interventions that will improve health at present, as well as reduce vulnerability in the future. WHO called upon Member countries, individuals, communities and corporations to strengthen health systems and change policies, such as the use of cleaner energy and more sustainable transport systems, and policies to reduce GHG emissions.

WHO observed World Health Day 2008 with the theme of "Protecting Health from Climate Change" to raise awareness and public understanding of the health consequences of climate change and ignite the commitment of governments, international organizations, donors, civil societies, businessmen and communities to put health at the centre of the climate change agenda. It was resolved to strengthen primary health care to address the MDGs and maintain vigilance on the social determinants of health.

The 2008 WHA Resolution (61.19)<sup>75</sup> recognized the need to identify appropriate and comprehensive strategies and measures; build capacity in the health sector; work with government and NGO partners to raise awareness of the health impacts of climate change, and take action. It also urged Member States to integrate health measures into plans for climate change adaptation; enhance the capacity of public health leaders to be proactive in providing technical guidance on health issues, and support the necessary rapid and comprehensive actions including investments and plans at the national level; and strengthen the capacity of health systems to monitor and minimize the public health impacts of climate change. The Resolution requested the Director General (DG) of WHO to consult Member States and prepare "a workplan for scaling up WHO's technical support to Member States for assessing and addressing the implications of climate change for health and health systems", including practical tools, processes for facilitating exchange of information, best practices and coordination between Member States.<sup>75</sup> Accordingly, a global workplan was developed with four objectives: (i) advocacy and awareness-raising; (ii) engaging in partnership with other UN organizations and sectors other than the health sector at national, regional and international levels to position health centrally; (iii) promoting and supporting generation of scientific evidence; and (iv) strengthening health systems to cope with

the health threats of climate change, including extreme weather events and sea-level rise. WHA 61.19 also requested the DG to engage actively in the UNFCCC Nairobi Work Programme along with Member States to harvest the benefits of its outputs, including work on health protection strategies and measures, health impacts of potential adaptation and mitigation measures in other sectors, surveillance and monitoring, and assessment of the likely financial costs and other resources.

WHO's Mid-term Strategic Plan 2008–2013 flagged climate change issues. For example, the Organizationwide Expected Result 8.6 of WHO envisions "Evidence-based policies, strategies and recommendations developed, and technical support provided to Member States for identifying, preventing and tackling public health problems resulting from climate change."<sup>81</sup>



## OBJECTIVES AND OUTCOMES

### 2.1 General objective

The overall objective of this strategy document is to assist the health sectors of SEARO Member States to assess the health vulnerability of the people and the sector itself, and use the assessment experience to plan and implement adaptation measures against the health impacts of climate change in Member States.

### 2.2 Specific objectives

1. Provide sufficient background for conducting situation analyses to gauge health risks, vulnerability, and adaptation skills and requirements to deal with climate change;
2. Explore avenues to conduct operational and applied research to assess the efficiency and effectiveness of adaptation plans and their implementation;
3. Assist in developing, reviewing, implementing and monitoring plans to adapt to the health impacts of climate change effectively and efficiently;
4. Support the health sector focal points of Member States to take the lead in protecting health from climate change within and outside the country.

### 2.3 Expected outcomes

This strategy document will assist Member States in managing their health risks from climate change efficiently. It will help in generating information for better understanding of the health vulnerability of the people and the health

sector to climate change. This will lead to an effective plan and enhanced capacity of the people and the health sector for efficient implementation of the plan, resulting in adequate adaptation of the health sector and the people to the health risks of climate change.

## 2.4 Indicators

1. Member States have updated their national strategy document in light of this Regional Strategy document in 2012;
2. Member States have developed their national strategy document based on this Regional Strategy document in 2012.



## STRATEGIC ACTIONS

### 3.1 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 of present and future, direct and indirect human risks,
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 of critical institutions, and the derivative allocation of decision-making authority;
- the decision-making criteria that would be employed;
- the stock of human capital, including education and personal security and people's and communities' experience;
- the stock of social capital, including the definition of property rights;
- the system's access to risk-spreading processes;
- the ability of decision-makers to manage information;
- the processes by which these decision-makers determine which information is credible and the credibility of the decision-makers themselves;

- the public's perceived attribution of the sources of stress and awareness that a problem exists (i.e. understanding the causes, a sense that the problem matters, the capability to intervene or influence);
- the political will and processes to deal with the problem; and
- assemblage of the prerequisites required for prevention.

## Types of vulnerability assessment

### 1. 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 adaption 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 scenario with global warming. 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.

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 or future risks of vulnerability to climate change at present or 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 costs involved in adaptation by areas of adaptation, e.g. 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; 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:<sup>82</sup>

- Specify the health risks to be addressed in the impact assessment, e.g. malnutrition, diseases or the causes of diseases (e.g. vector type? vector breeding site? people's behaviour to avoid getting bitten?).
- Specify what types of exposure will be measured and up to what range/degree, e.g. to extreme weather conditions (if so, which one). Will it be, for example, heat waves of up to 45°C? To sea storms of type 4 severity?
- Estimate the distribution of the exposed population and why (and the degree of exposure). Which populations were exposed? Which

ones were the most exposed and which were the least? Where? (A useful approach would be to develop a vulnerability map.)

- Estimate the effect/impact of the exposure, e.g. how many became ill, how many died, etc.
- Select appropriate (expected) health outcome(s), i.e. 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, e.g. 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, e.g. supportive policy, technology, funds, etc.
- 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 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.
- Quantify the uncertainty of the estimate, i.e. the degree of surety that these events and effects/impacts may be due to climate change.

These assessments provide a means of estimating the number of people who can be expected to be vulnerable, to what degree, why and who they are, and the cost to strengthen their resilience. Together with a cost-effectiveness analysis, this assessment offers quantifiable evidence to the decision-maker to prioritize interventions.<sup>83</sup>

Assessment of vulnerability has to proceed case by case, area by area and sector by sector. For example, vulnerability to water resources/aquifers should also form a part of the overall vulnerability assessment.<sup>84</sup> Similarly, facets such as housing, economy, topography, geography, etc. create a risk for vulnerability, which should therefore also be included in any 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, e.g. 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.

## 2. Predictive models of climate change for assessment of future risks

The regional climate change-impact models such as Providing Regional Climates for Intervention Studies (PRECIS) are designed to be used as inputs to models of weather-related events, such as diseases.<sup>85</sup> Additionally, the population distribution of the exposure may be obtained by using the Hadley Centre Coupled Model, version 3 (HADCM3) climate model, which describes future climates under various scenarios of GHG emissions.<sup>86</sup> More robust and locally usable models are also being developed, which need to be examined. Recent models give better resolution when downscaled for geographical regions. For coastal and small island landmasses, a coupled atmospheric and oceanic model has been advocated by experts.<sup>87</sup>

The Health Forecasting Service of the UK 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, e.g. chronic obstructive pulmonary disease (COPD) and seasonal affective disorder (SAD). Simple, anticipatory care measures such as gentle exercise, monitoring and maintaining rooms at the right temperature, use of light boxes, helps to keep the individual well and reduces the need to access expensive health care. Experience of these kinds may be explored further for Regional adoption.<sup>87–90</sup>

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.<sup>91</sup>

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.<sup>92–108</sup> These experiences are worth exploring and utilizing.

## 3.2 Adaptation to climate change

Adaptive capacity is influenced by factors that promote or constrain the adoption of technologies and management practices. It is also influenced by economic, social, political, environmental, institutional and cultural factors, and prowess, which create external and internal incentives or barriers to adaptation. A study by the World Bank<sup>109</sup> using econometric models developed by WHO showed that, as income increases, the incidence of disease decreases. 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, technology, education/information and institution/infrastructure.

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) measures to be put into operation.<sup>110</sup> A web-based climate information decision-support tool has been developed by the German Weather Service (DWD) and provides probabilistic information about the imminent heat situation for the next 0–14 days at the regional level.<sup>111</sup> Similar adaptation techniques will be useful for SEAR countries as well. Climate change-related interventions therefore need (i) to be mainstreamed, (ii) to explore new mechanisms and tools, and (iii) 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/proactive or 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 public or private. The same intervention may be planned and implemented *a priori* or *a posteriori*, e.g.

incentive for relocation of housing, industries; change of farming processes by season, timing or cultivars (e.g. drought- or saline-resistant plants).

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

As per the Earth Summit,<sup>112</sup> the national targets for the health sector may 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 infections and filarial infections.

The other Rio targets that ought to be pursued are: establishment of an appropriate and adequate national infrastructure and programmes for preventing environmental injury and 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 has 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 impacts as a condition for approving the establishment of industrial plants, institution of monitoring and assessment, and research.

## **Localization of adaptation**

Since vulnerability is localized, 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; immunocompromised people and those with chronic 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, geographical, topographical and epidemiological 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 adaptation

***Regulation and infrastructure development:*** 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 practising measures aimed at emission reduction and adaptation. They need to have the technology, information and financial support to adopt these.

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 infrastructure support, such

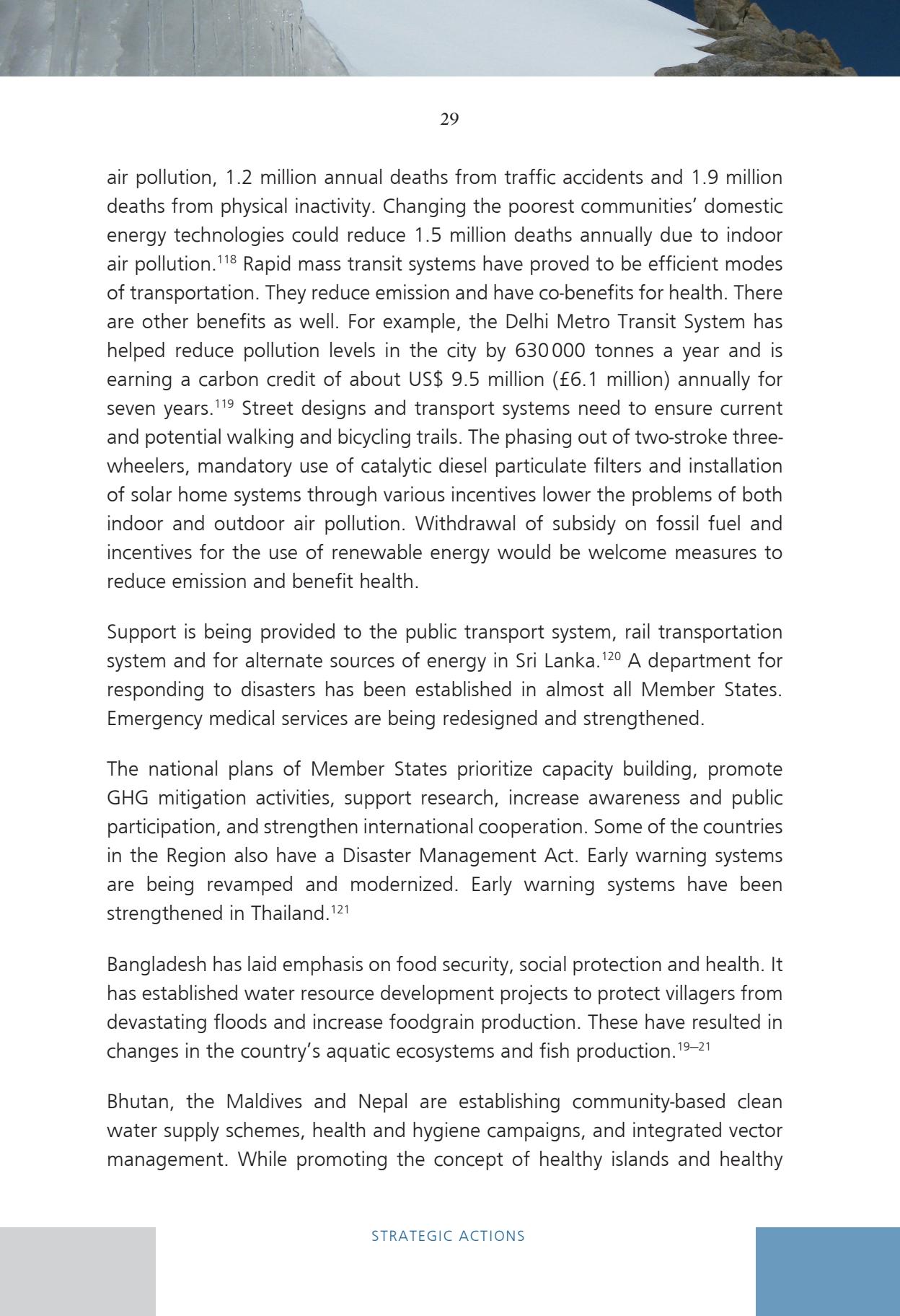
as transportation and electricity. There is also a need to monitor the effect of the efforts made in other sectors.

Relevant health and environment policies and legislations are warranted. Individuals in the government have to be identified and entrusted with the responsibility for formulating and implementing these. 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 programmes. Linkages between health and environment policies are important. Stakeholders of the health impact of climate change also need to understand the impacts of climate change on the economy by the way of health adaptation.

Regional Member States have some effective legal frameworks. Laws exist on the protection of forests and wildlife and wild plants in Myanmar. 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 and coordinate national policies and strategies, including policies for carbon trading, programmes and assessments on climate change mitigation and adaptation, technology transfer and financing, and for monitoring and evaluating climate change policies. Alternate energy sources, efficiency in energy use, land use, forestry, mining, and marine life and biopreservation have been covered by laws.<sup>113–116</sup>

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.<sup>117</sup>

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. Public transportation reduces CO<sub>2</sub> emission, thereby helping to reduce the 800 000 annual global deaths from outdoor



air pollution, 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.<sup>118</sup> 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 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 seven years.<sup>119</sup> 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 in Sri Lanka.<sup>120</sup> 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 in Thailand.<sup>121</sup>

Bangladesh has laid emphasis on food security, social protection and health. It has established water resource development projects to protect villagers from devastating floods and increase foodgrain production. These have resulted in changes in the country's aquatic ecosystems and fish production.<sup>19–21</sup>

Bhutan, the Maldives and Nepal are establishing community-based clean water supply schemes, health and hygiene campaigns, and integrated vector management. While promoting the concept of healthy islands and healthy

buildings, the Maldives envisages strengthening the capacity for health-care delivery and dealing with medical emergencies. The country will prioritize campaigns to promote better nutrition and integrated vector management. More research on climate change-related diseases is also planned.<sup>79</sup>

Some SEAR countries are also contemplating the practice of supplying information on the environmental characteristics of a commodity to consumers, also known as eco-labelling, as a tool for controlling emission. Perpetual/sustainable and eco-friendly packaging is also being considered for future marketing.<sup>122</sup>

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 health sector 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 agency.

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, funding for research and awareness building will be useful.

***Intersectoral and intrasectoral collaboration:*** Crop cultivation influences vector-breeding and vector-borne diseases influence agricultural production. On the other hand, rampant agropesticide 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 irrigation and insecticide use, insects that cause human diseases from



diseases in animals, efficiency in irrigation to protect water quality and quantity, reduction in the use of agrochemicals, peridomestic sanitation to prevent breeding in containers, and clearing canals, drainage, filling ditches, etc. Similar collaboration with other sectors, such as energy, transportation, forestry, education, housing, public health engineering, among others, is also imperative. In view of the fall in foodgrain production due to global warming and increase in CO<sub>2</sub> in the atmosphere, some new laws will be required to control the market. This will result in reduced exposure to key distortions in international agricultural markets. 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, e.g. vertical child and maternal health programmes and climate change, surveillance and climate change.

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.

Interministerial forums need to review the co-benefits 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 implementation of plans 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. A clearance from the Ministry of Environment may be made mandatory for all projects that would affect the environment and climate. This mechanism may also ensure financing and costing of projects for co-benefits at the planning and implementation level.

As the role of the Finance Ministry in climate change negotiations is important, it is necessary that the Ministry of Finance participates in meetings and conferences on climate change along with the Ministry of Environment, even when the subject seems entirely health related.

### **International collaboration on adaptation and mitigation**

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 the issues alone. The Regional level thus represents a critical middle ground for negotiations as they concern sustainable development-related international governance, with the potential to encourage 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, and mandates and covenants that overshadow climate change-related developments, decisions and

technical support. This will be useful for international negotiations on funding and technology transfer.

## **Measures for mental health**

Country capacity for relevant 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. Poor people's sufferings 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 a fall-out 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**

Seasonal large-scale fruit processing plants 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. As many countries of the Region do not treat waste before discharging it into water bodies, local environmental degradation has occurred. Existing environmental laws cover marine pollution control, use of pesticides, fishing and conservation of fishery resources, shipping, etc. However, enforcement mechanisms are inadequate due to institutional, strategic and financial constraints.<sup>123</sup>

Among food, as fish and chicken are responsible for the least amount of emission and are also sources of good protein, these foods need to be encouraged. Dependence on sea fish would probably have to be reduced and local cultivation encouraged.

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.

## **Measures in the housing sector**

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 to 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.<sup>5</sup> 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.

Some of the recommendations on housing of the Commission on Health and Environment of WHO,<sup>32</sup> 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, e.g. 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<sup>32</sup> for the housing sector are:

- To conduct a health impact assessment (HIA) of proposed housing and co-benefits to health;
- To 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 (e.g. 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;
- To 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;
- To institute appropriate standards and codes, and avoid hazardous materials (e.g. 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 foam boards containing carcinogens and endocrine disruptors);
- To consider the impacts of GHG at all stages of building construction and use;
- To design houses that facilitate safety, independent mobility of and free access for children, older adults, women and other vulnerable groups;
- To 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%.<sup>124</sup> A combination of insulation and upgradation of the heating system results in an improvement of 0.56 months of life saved per person.<sup>125</sup> Window placement can also have an impact on thermal protection and the health effects of extreme heat or cold. The location of bedrooms and 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.<sup>126</sup> There are other features that combine cost, energy efficiency, cooling, lighting, GHG emission, and health and durability aspects.<sup>127–131</sup> Entitlement to land in urban slums, however, is an impediment that needs to be addressed if MDG 7 is to be attained.<sup>63</sup>

## **Management of water resources**

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."<sup>132,133</sup> South Africa is one of only a few countries to expressly recognize the human right to water in its Constitution. In 1994, the Government established a goal of providing free basic water, up to 25 litres of water per person per day, to every poor household 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.<sup>134</sup> Some of the measures required to attain water security may be as follows:

- Provision of safe waste water 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;

- Rain water 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 and medicines into water. Floods, in particular, carry and distribute these toxic materials to far-flung areas. The irrigation system and some other water-based agricultural and mining practices emit methane and CO<sub>2</sub>, and also spread 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**

Recent studies<sup>133</sup> have shown that in India, the national programme offers low-emission stove technology for burning local biomass fuels. This will not only reduce CO<sub>2</sub> 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. A study found that changing methods of electricity generation to reduce CO<sub>2</sub> emission would reduce particulate air pollution and deaths.<sup>135</sup> A best-case scenario for reducing such pollutants would save an additional 1500 life-years per million people per year in India, and save an estimated additional 500 life-years per million people per year in China.<sup>5</sup>

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.<sup>87</sup> Transfer of this technology would be useful for SEA Member States.

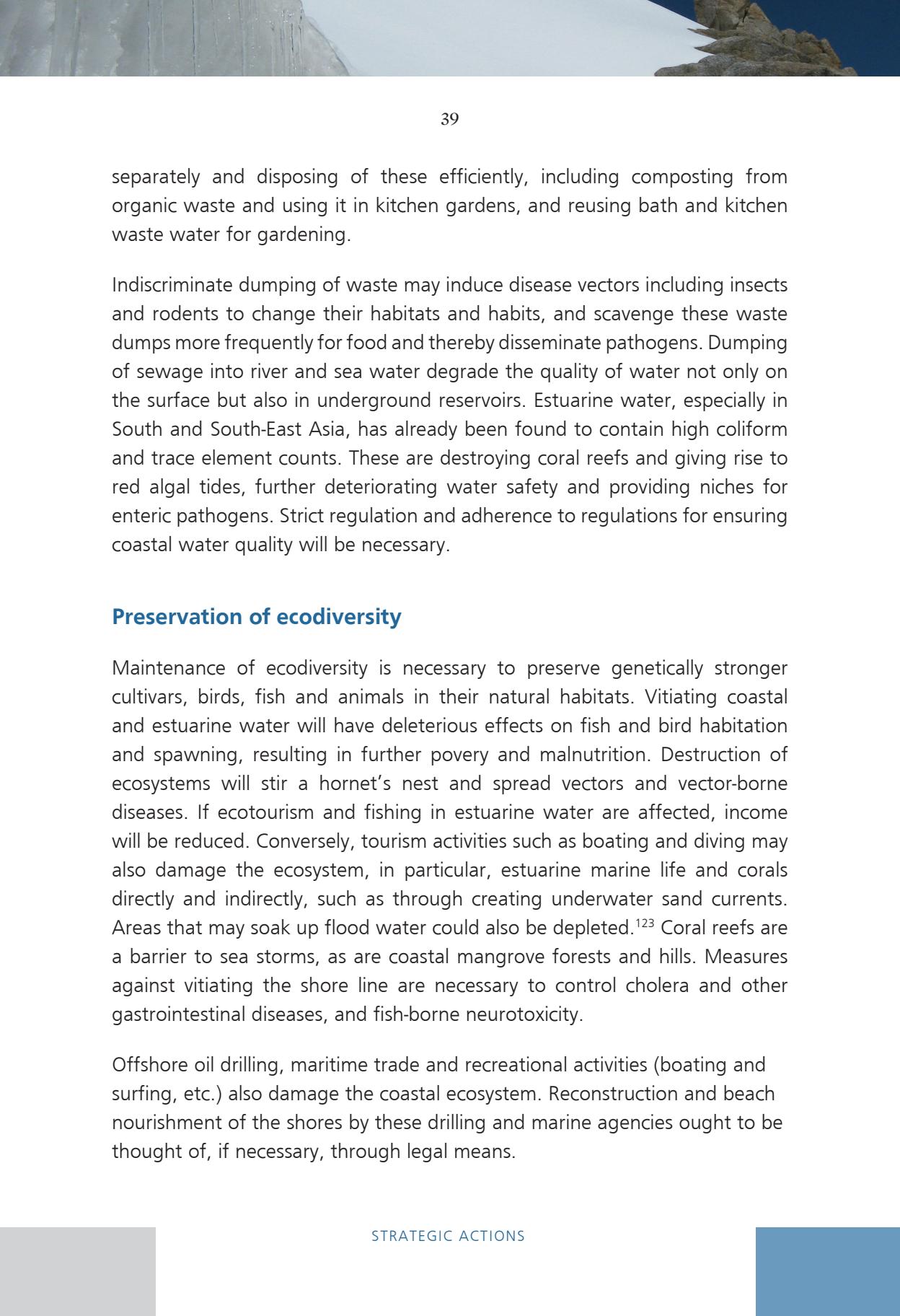
## **Waste management**

The WHO Commission on Health and Environment<sup>32</sup> stressed on a healthy work environment and waste management through the following means:

- Control technology on 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;
- Educational and training activities for policy-level personnel, health-care professionals, workers and managers on health, safety and environmental sanitation including waste management; for journalists and others in the media; the public and especially schoolchildren, to increase their understanding of environmental problems; and 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. 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.<sup>136</sup> Movement of hazardous waste across borders, controlled by the Basel Convention,<sup>137</sup> 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, e.g. 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.

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. Strict regulation and adherence to regulations for ensuring coastal water quality will be necessary.

## Preservation of ecodiversity

Maintenance of ecodiversity is necessary to preserve genetically stronger cultivars, birds, fish and animals in their natural habitats. 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.<sup>123</sup> Coral reefs are a barrier to sea storms, as are coastal mangrove forests and hills. Measures against vitiating the shore line are necessary to control cholera and other gastrointestinal diseases, and fish-borne neurotoxicity.

Offshore oil drilling, maritime trade and recreational activities (boating and surfing, etc.) also damage the coastal ecosystem. Reconstruction and beach nourishment of the shores by these drilling and marine agencies ought to be thought of, if necessary, through legal means.

## **Adaptation measures for migrants, urbanization and population growth**

Human migration will be the greatest impact of climate change due to soil erosion, coastal flooding, drought and agricultural disruption. It is estimated that there will be 200 million forced migrants by 2050 due to climate change.<sup>138</sup> This will affect the socioeconomic fabric of those who migrate as a consequence. 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. Since migration destabilizes the disease situation, it is necessary that any community created due to migration is put under surveillance for some time for the emergence of diseases in areas with migrants, and the necessary infrastructure 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 in further spread of existing city slums. According to the Asian Development Bank (ADB), there were 827 million slum dwellers in 2010 from 777 million in 2005.<sup>1</sup> Measures taken to alleviate the poor living conditions of people should give priority to women for various reasons.

Consumption is the driving force behind emission. The bigger the population, the more the consumption, and need for other utilities and 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**

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, the equipment should be functional, continuity of communication (telephone), electricity, water and sanitation should be

ensured, and service providers should be courageous enough to be available to provide services even in the face of threats to their own life. Hospital preparedness in emergencies (HOPE)<sup>139</sup> 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. Capacity to assess damage to hospitals should also be inculcated.

## **Disaster response**

Disaster risk reduction (DRR) is an essential part of adaptation as the first line of defence against the impacts of sudden climate change. In any disaster response, triage is important; priority needs to be given to women, children and breadearners.

A comprehensive risk reduction culture needs to be central to all efforts. There may be two major components of a comprehensive disaster management model – risk reduction 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, deployment and operation of early warning systems including collaboration with other relevant sectors for access to forecasts, mass casualty management, 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.

## Public health measures

Global warming will increase the prevalence and incidence of existing endemic diseases. The most important health response to the impacts of climate change would therefore be strengthening the health system to respond to the present and additional burden of these 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, 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%.<sup>140</sup> Of about 13 million deaths/year globally, 4 million could be prevented by improving water, sanitation, and indoor and outdoor air pollution.<sup>33</sup>

Institutional capacity is required for managing cases of heat stress. Usually, in SEAR countries, there is no early warning system in place for a heat wave. This could be improvised using the print and mass media, e.g. 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 issues have therefore 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.
- 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.
- Establish an integrated vector risk and disease surveillance and management system.
- Develop the capacity to issue seasonal forecasts of extreme weather conditions such as drought, rain and flood, snowfall, hail storm, land- and sea-based storms and surges, water level rise, erosion, landslide, bursting of dams, pestilence, etc.
- Strengthen infectious and noncommunicable disease control programmes.
- Develop vaccines and institute vaccination programmes.
- Strengthen community-based neighbourhood support/watch schemes and other empowering measures.
- Build ecofriendly/green and climate-proof “cooler” urban layouts and physical facilities, and ensure the safety of the physical structure of health facilities.
- Develop and monitor risk indicators (e.g. endemicity rate, mosquito numbers, aeroallergen concentrations, etc.).
- 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.

- 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. 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.
- Arrange for appropriate workforce training and retention, including the capacity for logistics management, technology transfer and absorption, and programme and personnel management capacity.
- 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.
- Collaborate with other sectors and train them to derive co-benefits in health.

### **Capacity building: strengthening health systems**

Capacity building will be based on the baseline and follow-up situation which, as has been stated earlier, should be assessed periodically.

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 private sector is involved in reducing and responding to climate

change. To garner support, it is necessary to brief opinion-makers including celebrities, and orient and use them for communication.

Developing national communication strategies and plans needs to be based on a thorough needs assessment. The thrust of communication would be to make people and their leaders pro-active and let them understand how their acts may increase or reduce emission. 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 messaging process 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 of health staff needs to be provided according to their functions and competency. Building leadership skills is required for managers, planners and other decision-makers. 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; and research. Training is also needed on climate models and risk assessment skills.

Primary health-care systems must be strengthened so that the physical infrastructure becomes strong enough to withstand the onslaught of climate change, and be effective enough to support people in their fight against the impacts of climate change. Strengthening of the primary health care system also needs to involve the community in the process of strengthening and in managing and maintaining the system.

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

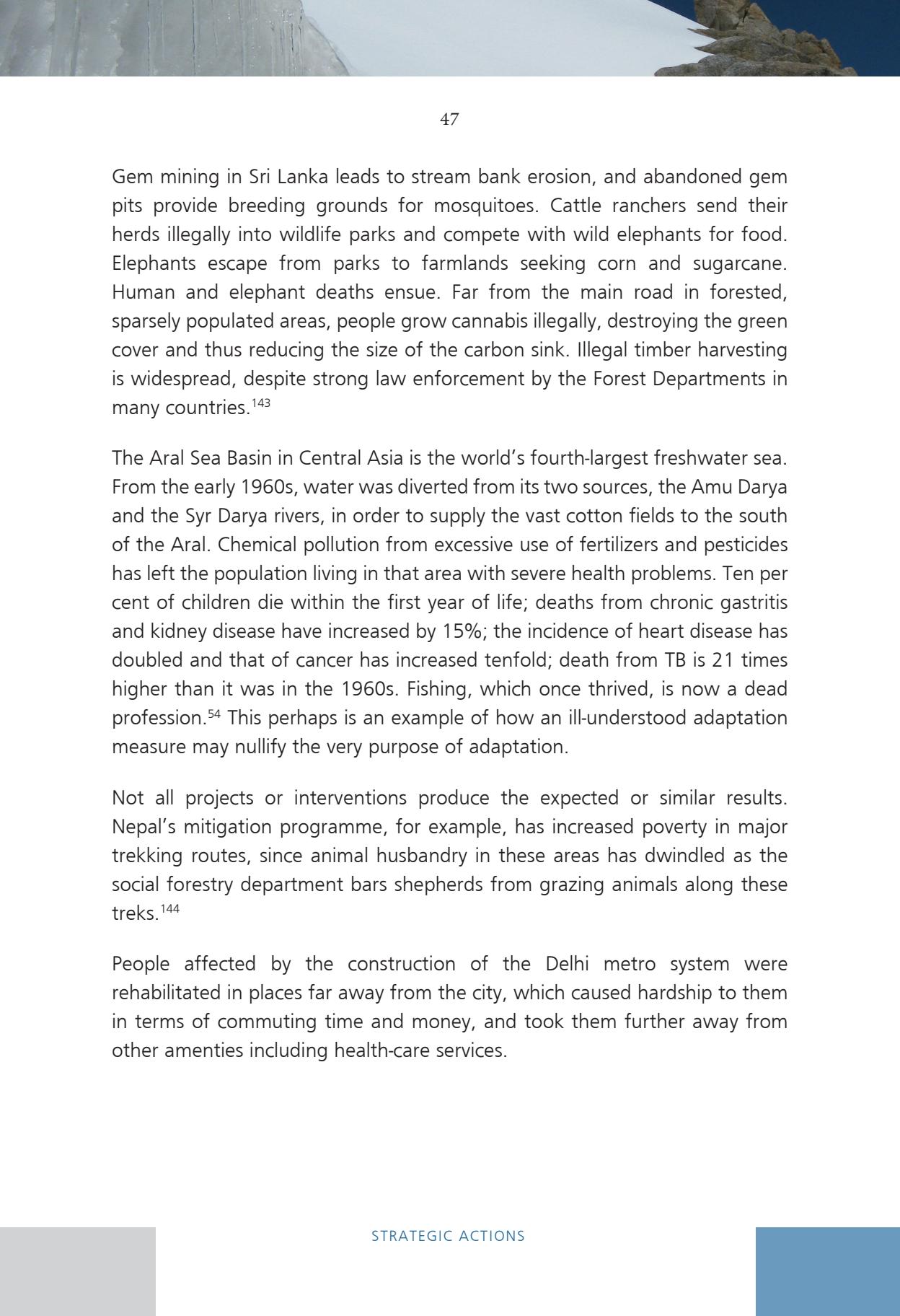
Adaptation and mitigation in the health sector would require technology transfer from Kyoto Annex II countries as per the covenant of the UNFCCC (Article 4 of the UNFCCC).<sup>141</sup>

A standardized list of logistics by tier including medicines, kits, equipment and machines may be prepared for addressing the different types and degrees of impacts. These 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 disesases need to be developed, if not done already, or reviewed in light of the future impacts of climate change with prevention in mind.

## Taking care of the adverse effects of adaptation

Adaptation measures may be self-defeating if their aftermath is not considered. For example, reclaiming of 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, eco-tourism, coastal recreation and harbour construction also cause sedimentation and turbid water that can kill coral and change the composition of fish species.<sup>142</sup>



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. Elephants escape from parks to 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.<sup>143</sup>

The Aral Sea Basin in Central Asia is 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, is now a dead profession.<sup>54</sup> This perhaps is an example of how an ill-understood adaptation measure may nullify the very purpose 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.<sup>144</sup>

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.

### 3.3 Mitigation of greenhouse gas emission

Co-benefits from reduction in GHG emission can offset a substantial fraction of the need for and cost of mitigation and 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%.<sup>42</sup> Collaboration with other sectors such as forestry, agriculture, transportation, energy, industry and water resources management is necessary to reduce emission.

#### **Measurement of the carbon footprint in the health sector**

Methods described elsewhere<sup>145–148</sup> may be used to measure the carbon footprint in health-care facilities.

#### **Mitigation of greenhouse gas emission**

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 also help the health sector in mitigating GHG emission and selling carbon credit. Retrofitting of machines, equipment and phycial facilities may be one of the avenues for technology transfer from funds received for climate change. Communication materials on mitigation of emission at the family and corporate levels are available. The health sector could use these materials to enhance awarness 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 sector and other sectors.

## 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.<sup>149</sup> This experience may be adapted in large hospitals.

Buildings account for at least 36%–40% of energy use in most countries.<sup>150</sup> In air-conditioned offices, however, buildings are responsible for 50%–55% of emission.<sup>124</sup> In the European Union, 40% of GHG is emitted from buildings, more than the 30% by industry and transport (12% from passenger cars).<sup>125</sup> 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.<sup>5,151–153</sup> 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, rain water 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.<sup>126</sup> These and some other ventures are worth exploring.

Among the renewable energy sources, wind, biomass, storm, biogas, geothermal, water current and photovoltaic cells will be the most expensive in future (by 2050),<sup>154</sup> although solar photovoltaic cells and the micro-hydro system are leading technologies that supply renewable energy in developing countries at present.<sup>155</sup>

Electric cars or fuel-efficient batteries may be useful for ambulances. 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.<sup>156</sup> Conversion of vehicle engines that use fossil fuels to those that use compressed nitrogen gas may be a stop-gap 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 counterproductive. Plantations for biofuels may reduce the availability of foodgrain to the poor. 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.

### 3.4 Research, monitoring and evaluation, and review

Monitoring and evaluation (M&E) and review are necessary to ensure that implementation follows the plan 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).

It will be useful to create national and sector-wise GHG inventories as per the IPCC II<sup>157</sup> and in accordance with Article 12 of the UNFCCC.<sup>158</sup> 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 diseases with endemic and epidemic potential. This would also be useful in assessing

the epidemiological trends of climate-sensitive diseases. Creating local hazard maps, and 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 in taking timely decisions for managing adaptation measures, along with monitoring, review and evaluation of implementation of plans.

### **Priority activities for the health sector**

1. Establish effective climate response units capable of international negotiation on funds and technology transfer, within-country knowledge management, and programme planning and implementation.
2. Develop a plan based on national and international evidence.
3. Ensure the adequacy and appropriateness of human resources, logistics and operational funds at all nodal levels.
4. Adequately improve the management and technical capacity of human resources, including communication and counselling skills.
5. Strengthen surveillance systems at appropriate levels to monitor risk factors/behaviour, water and air quality, food safety, the effects of chemicals (fertilizers, pesticides, medicines) in the environment, vectors, diseases and malnutrition.
6. Strengthen the research system to assess vulnerability and 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.
6. Develop skills to predict future disease potential under different emission scenarios and possible warming.
  7. Strengthen referral systems and the health system's capacity to prevent, control and manage diseases.
  8. 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.
  9. Strengthen and ensure effective and efficient utilization of early warning systems.
  10. Strengthen supervisory and M&E functions.
  11. Involve the community and other stakeholders including the relevant sectors and service providers in joint planning, implementation and M&E with the aim of strengthening community resilience and enhancing co-benefits from other sectors.
  12. Strengthen effective and efficient disaster response mechanisms.
  13. Improve environmental quality, i.e. quality of air and water, and waste management.
  14. Identify and map vulnerable populations and their locations by their degree and cause of vulnerability, and prioritize adaptive measures accordingly.
  15. Enhance skills to manage natural hazards and mass casualties.
  16. Enhance skills to manage international support either in emergency situations or in slowly evolving cases of health problems.
  17. Ensure hospital safety and user-friendly designing of hospitals.
  18. Establish effective intersectoral collaborative arrangements for mitigation and adaptation, keeping in mind the centrality of health and for deriving health co-benefits.

19. Plan and implement communication strategies and activities to raise community knowledge for improving resilience and mitigating emission. These include the use of renewable energy, mitigation at the family and corporate levels, facilitation of intra-stakeholder collaboration and coordination, and policy and programme support.
20. Develop skills for risk communication, counselling and undertaking psychological measures where needed.
21. Reduce consumption, recycle waste and reuse commodities (this may even extend to the destruction of useless and harmful trees, plants and shrubs which soak up water, and replacing them with economically and environmentally useful ones).
22. Measure carbon footprint of health facilities regularly and take measures to reduce it
23. Wastes may be injurious to health as well as a source of greenhouse gas emission. Arrange waste disposal from all sources (home, hospital, industry etc.) following all safety measures and in a manner that reduces the possibility of greenhouse gas emission
24. Support overall national economic and technological development.



## FINANCING AND PLANNING

### 4.1 Costing and financing for adaptation

Every US\$ 1 invested in pre-disaster risk management in developing countries would prevent losses of US\$ 7.<sup>159</sup> 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<sup>160</sup> estimates that "if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5 per cent of 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 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. Climate change mitigation and poverty reduction should be addressed simultaneously. Likewise, many needed technologies, e.g. biomass use, are not yet available in developing countries. Collaborative research and development (R&D) between developing and developed countries and R&D institutions is necessary to address this gap. This may be done through a venture capital fund located in a multilateral financial institution.

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.<sup>161</sup>

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.<sup>162</sup> 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<sup>163</sup> 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<sup>163</sup>**

Emission scenario*	Diarrhoeal diseases		Malnourishment		Malaria	
	Middle	High	Middle	High	Middle	High
S550	1706	6024	63	131	1859	3876
S750	1983	6814	95	189	2310	4784
UE	2731	9010	72	146	3664	7537

\* S550: stabilization of emission at 550 ppm CO<sub>2</sub> equivalent; S750: stabilization of emission at 750 ppm CO<sub>2</sub> equivalent; UE: unmitigated emission

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, e.g. dengue, heat and 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<sup>163</sup> 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).<sup>1</sup>

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.<sup>164</sup>

## 4.2 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<sup>165–167</sup> is also important to impress development partners that the funds sought are for genuine purposes.

SEAR countries need to liaise with the Subsidiary Body for Scientific, Technical and Technological Advice and the Subsidiary Body for Implementation of the UNFCCC. In addition, the Ad-hoc Working Group on Long Term Cooperative Action and the Ad-hoc Working Group on Further Commitments for Annex I Countries also need to be understood well for better informed negotiations and decisions.

For international negotiation and funding, it is necessary for Member States to exhibit strong proof that climate change is high on their agenda,<sup>41</sup> 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 – human, logistics and technology.

As may be noted, 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.<sup>168</sup> 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, e.g. carbon credits of up to 35 million tons to India and 182 million tons to China/year.

### 4.3 Logframe (annexed)



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# **ANNEX:**

## **LOGFRAME**

### **TO PROTECT**

#### **HEALTH**

##### **FROM**

###### **CLIMATE**

###### **CHANGE**

## ANNEX: LOGFRAME TO PROTECT HEALTH FROM CLIMATE CHANGE

ULTIMATE OBJECTIVE: People's health and health infrastructure are resilient to the effects of climate change

INTERMEDIATE OBJECTIVE: Enabling sustainable and synergistic adaptation of the health sector and the people to the impacts of climate change on health

IMMEDIATE OBJECTIVE: To mainstream climate change dimensions into health systems

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		
Activities	Verifiable indicators	Source of verification
1. Establishment of an office with (i) focal points, (ii) terms of reference, (iii) technical committees/working groups to support the focal point, (iv) skilled staff, (v) logistics, and (vi) funds	1. Focal point/coordinator's office is functioning effectively	1. Programme report
2. Establishment of an efficient intersectoral organizational network within and between the countries and regions	1. Effective exchange of information and experiences between different levels, sectors, countries and regions	1. Spot verification 2. Programme evaluation
EXPECTED RESULT 2: CLIMATE CHANGE UNIT IN THE COUNTRY AND AT SEARO ARE MANAGING KNOWLEDGE EFFECTIVELY		
Activities	Verifiable indicators	Source of verification
3. Development of tools to assess and monitor vulnerability and adaptation skills, and their periodic updating	1. Availability of the tools	1. Programme evaluation
4. Conducting periodical assessment of vulnerability, and adaptation skills and processes	1. Incidence of climate-sensitive diseases	1. Programme report
5. (i) Enlistment of the areas where the health sector can employ greening efforts and the present greening efforts, (ii) Periodic assessment of the carbon footprint of the sector	1. Measurement of the carbon footprint	1. Programme evaluation/programme report
6. Study of existing plans and initiatives of the sector and other sectors and development partners for co-benefits and conducting other required research work	1. Percentage of study findings that were used for decision-making	1. Programme evaluation/programme report
7. Development of a hazard map by type, magnitude, location and population characteristics, and its periodic updating	1. Availability of hazard map	1. Programme report
8. (i) Establishment of an effective surveillance, research, monitoring, review, supervisory and feedback mechanism  (ii) Establishment of an effective early warning system  (iii) Establishment of a disaster preparedness and response system	1. Functioning of nodal-level laboratories  2. Incidence/prevalence rates of climate-sensitive diseases  3. Effectiveness of the early warning system	1. Spot verification  2. Programme evaluation/programme report  3. Programme evaluation

Logframe to protect health from climate change (continued)

<b>OUTPUT 2: FUNCTIONING OF AN EFFECTIVE AND EFFICIENT MANAGEMENT SYSTEM</b>		
<b>EXPECTED RESULT 1: MEMBER STATES HAVE EFFECTIVE POLICY, STRATEGIC DIRECTION, PLAN AND MANAGEMENT SUPPORT</b>		
Activities	Verifiable indicators	Source of verification
9. Development of in-country capacity for intersectoral leadership and global negotiating capacity (of health sector professionals, managers and policy-makers)	1. Effectiveness and efficiency of adaptation and mitigation activities	1. Programme report 2. Programme evaluation
10. Development and enactment of effective and relevant policies, regulations, strategies and plans	1. Effectiveness of the regulations	1. Programme evaluation
11. Empowerment of Member States to participate and negotiate in national and international processes and decisions, and acquire funds and technology	1. Adequacy of the funds and technology mobilized/transferred for the health sector	1. Programme report
<b>EXPECTED RESULT 2: GREATER MANAGEMENT EFFICIENCY AND EFFECTIVENESS HAVE BEEN ATTAINED THROUGH COLLABORATION</b>		
Activities	Verifiable indicators	Source of verification
12. (i) Establishment of an intersectoral collaborative mechanism for deriving co-benefits; (ii) links between biological and environmental data	1. Demonstratable derivation of co-benefits 2. Collaboration between the health and meteorology departments	1. Programme report
13. Establishment of regional centres of excellence and collaborating centres	1. Quality of support from the regional centres	1. Programme evaluation
14. Strengthening of regional networks of practitioners, and collaboration with national and international technical experts	1. Effectiveness of the support from networks and experts	1. Programme evaluation
15. Effective and efficient transfer of technology including measurement of the carbon footprint of health facilities	1. Level of satisfaction in using the technology transferred	1. Programme report
16. Continuously conducting monitoring and supervisory visits and review meetings, including surveillance for diseases	1. Use of monitoring reports in decision-making	1. Programme report
17. Timely evidence-based decisions at nodal levels	1. Decisions circulated and abided by	1. Meeting minutes
<b>OUTPUT 3: HEALTH SECTOR AND THE PEOPLE ADAPT TO THE HEALTH IMPACTS OF CLIMATE CHANGE AND MITIGATE GREENHOUSE GASES EFFICIENTLY</b>		
<b>EXPECTED RESULT 1: INCREASED AWARENESS OF THE HEALTH CONSEQUENCES OF CLIMATE CHANGE AMONG ALL</b>		
Activities	Verifiable indicators	Source of verification
18. Advocacy to the public, policy-makers, managers, other sectors and donors for adequate resources and functional support	1. Percentage of national budget allocated 2. Value of co-benefits attained	1. Earmarked funds from annual budget 2. Programme evaluation
19. (i) Awareness building of the people, public leaders, managers and other sectors for efficient adaptation and mitigation in domestic and health-care settings, (ii) provision of training and logistics	1. Percentage of households practising mitigation and adaptation measures 2. Skill of health-care providers	1. Programme evaluation
20. Inclusion of climate change, and health and nutrition in institutional curricula at different levels	1. Knowledge of students on the impacts of climate change on health and nutrition	1. Programme evaluation
21. Implementation of adaptation plans	1. Prevalence rates of most common climate change diseases	1. Programme evaluation
<b>OUTPUT 4: EFFECTIVE REPORTING OF PROGRAMME IMPLEMENTATION</b>		
<b>EXPECTED RESULT 1: TIMELY AND COMPLETE REPORTS ARE AVAILABLE ON THE PROGRESS AND EFFECTS/IMPACTS OF THE ACTIVITIES</b>		
Activities	Verifiable indicators	Source of verification
22. Submission of progress reports to the Executive Board (EB) and WHA based on EB RC 5 and WHA 61.19, respectively	1. Percentage of required reports submitted in a timely and complete manner	1. Submitted report
23. Submission/transmission of in-country/Regional reports to relevant authorities and organizations	1. Percentage of required reports submitted in a timely and complete manner	1. Submitted report

## **Regional Strategy for Protecting Health from Climate Change**

This Regional Strategy for Protecting Health from Climate Change has been developed to fulfil the decisions taken at the 25th Meeting of Ministers of Health at Thimphu, Bhutan in 2007. The meeting urged WHO to formulate a Regional Strategy to combat the adverse health impacts of climate change. It also requested WHO 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/or updating their national strategies on climate change and health, and their national plans on protecting health from climate change.