The United Nations Intergovernmental Panel on Climate Change (IPCC), which shared the Nobel Peace Prize in 2007 for its work, has stated that “warming of the climate system is unequivocal”, and that the “primary source” of the increased concentration of carbon dioxide in the atmosphere is fossil fuel use. Thus, global warming is human-induced—and likewise, it is up to us to find solutions.

This is the first issue of *Health in South-East Asia*, which replaces the earlier newsletter *Window on SEAR*. It is hoped that its more compact size and more inclusive approach will help us to reach all of our partners and concerned communities. This newsletter is addressed not only to those who work in and with WHO in the South-East Asia Region for the betterment of health, but also to partners in aligned fields such as environment, agriculture, human resources, education and energy. More and more, we see that the health issues that confront us present multidimensional challenges, which in turn require multisectoral solutions.

Climate change is a perfect example of the need of partnerships and joint action, and it is fitting that this issue of *Health in South-East Asia* focuses on that topic. Climate change is a global problem whose effects are being felt in every corner of the world; its stakeholders include every person in our Region and beyond. To meet this enormous challenge will require action by governments, UN and other development agencies, the corporate sector, communities and individuals.

Even as intergovernmental bodies struggle to set and meet targets for the reduction of emissions of the greenhouse gases (GHGs) that cause climate change, the problem is already making itself felt in our area of prime concern: health. Climate change was the subject of this year’s World Health Day, with the theme of “Protecting health from climate change”. While the health sector needs to support all ongoing efforts to mitigate climate change by reducing GHG emissions and finding cleaner sources of energy—the health co-benefits are evident—we must match mitigation with adaptation, helping our communities to cope with climate change and reduce its negative impact on health.

Many of the predicted results of climate change are by now well known, such as more frequent and more violent storms, increased flooding, glacial melting, heat waves and rising sea levels. The direct health effects are obvious: heatstroke, injuries and deaths caused by cyclones and flooding, and even the disappearance of island...
states. Other consequences are less obvious; floods kill but they also destroy homes, harvests, and livelihoods, leading to hunger and the migration of populations—which in turn results in psychosocial stress and social conflict. As the climate warms new areas become hospitable to vectors such as mosquitoes, making the spread of malaria, dengue and other such diseases more likely. There is still much that we do not know about the effects of climate change, and more research is needed to fill the data gaps.

The South-East Asia Regional Office (SEARO) has distributed awareness and educational materials for World Health Day to publicize the need for urgent action (see www.searo.who.int). Some of the results are displayed here, for example the creative and compelling posters contributed by children in our Region. Action must follow in the path of awareness; already, together all the health ministers of the countries of our Region have declared climate change to be a major threat to health security. WHO will prioritise support for action to strengthen programmes that are aimed at reducing the health burden of climate-sensitive diseases. It will take all of our concerted efforts to meet this most unprecedented challenge.

Samlee Plianbangchang (MD., Dr. P.H.)
Regional Director

What is Climate Change?

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as “a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer”. Man-made greenhouse gases (GHGs) such as carbon dioxide are responsible for global warming. The IPCC reported that “The primary source of the increased atmospheric concentration of carbon dioxide since pre-industrial period results from fossil fuel use.” Global warming is now “evident” and “unequivocal”. Of the twelve warmest years on record from 1850 to 2006, eleven occurred between 1995 and 2006.
What is the IPCC?

The IPCC was founded in 1988 jointly by the United Nations Environment Programme (UNEP) and the United Nations World Meteorological Organization (WMO). It consists of several hundred scientists, and operates mainly through three working groups, which address: the physical scientific aspects of the climate system and climate change; vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it; and options for mitigating climate change through limiting or preventing greenhouse gas emissions and enhancing activities that remove them from the atmosphere. There is also a Task Force on National Greenhouse Gas Inventories.

What is the fourth assessment report?

IPCC produced a series of Assessment Reports (1990, 1995, 2001 and in 2007). The most recent publication is the four-volume Fourth Assessment Report (AR4), which was released in various steps throughout 2007. It involved more than 500 lead authors and 2,000 expert reviewers, and was submitted to the scrutiny of delegates from more than one hundred participating nations. It provides a synthesis that specifically addresses issues of concern to policy-makers: it confirms that climate change is occurring now, mostly as a result of human activities; illustrates the impacts of global warming already under way and to be expected in future, and describes the potential for adaptation of society to reduce vulnerability; and presents an analysis of costs, policies and technologies for limiting the extent of future changes in the climate system.

What are the projected health effects of climate change?

The health effects of climate change fall into six main categories:

♦ Respiratory infections and respiratory diseases
♦ Injuries
♦ Nutritional deficiencies/malnutrition
♦ Diarrhoeal diseases
♦ Vector-borne disease
♦ Psychosocial stress/diseases

Which countries in the South-East Asia Region will be affected?

All of them. For example, “Glacier melt in the Himalayas is projected to increase flooding, rock avalanches from destabilized slopes, and
affect water resources within the next two to three decades.” Meanwhile, flooding due to sea level rise will affect millions, and “the numbers affected will be largest in the mega-deltas of Asia and Africa, while small islands are especially vulnerable.” Food production will also be affected—“net cereal production in South Asia countries is projected to decline at least between 4 and 10% by the end of this century”—and will have consequences for human health. These are just some of the climate change-related issues the Region will face. The impacts of climate on

What are the probabilities for climate change risks?

<table>
<thead>
<tr>
<th>Phenomena of change</th>
<th>Human health</th>
<th>Likelihood of future trends(*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights.</td>
<td>Reduced human mortality from decreased cold exposure.</td>
<td>Virtually certain.</td>
</tr>
<tr>
<td>Warm spells/heat waves. Frequency increased over most land areas.</td>
<td>Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated.</td>
<td>Very likely.</td>
</tr>
<tr>
<td>Heavy precipitation events. Frequency increases over most areas.</td>
<td>Increased risk of deaths, injuries and infectious, respiratory and skin diseases.</td>
<td>Very likely.</td>
</tr>
<tr>
<td>Area affected by drought increases.</td>
<td>Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases.</td>
<td>Likely.</td>
</tr>
<tr>
<td>Intense tropical cyclone activity increases.</td>
<td>Increased risk of deaths, injuries, water–and food-borne diseases; post-traumatic stress disorders.</td>
<td>Likely.</td>
</tr>
<tr>
<td>Increased incidence of extreme (high) sea level (excludes tsunamis).</td>
<td>Increased risk of deaths and injuries by drowning in floods; migration-related health effects.</td>
<td>Likely.</td>
</tr>
<tr>
<td>Increased temperatures and disturbed rainfalls.</td>
<td>Contraction and expansion of the geographical range of disease vectors.</td>
<td>Likely.</td>
</tr>
</tbody>
</table>

(*): Using the Special Report on Emission Scenarios (SRES); From: Menne, WHO-EURO, 2007
human health will not be evenly distributed around the world. Developing country populations, particularly in islands, arid and high mountain zones, and in densely populated coastal areas, are considered to be particularly vulnerable.

**When will health affects of climate change begin to be felt?**

They are being felt already. It is estimated that climate change is responsible for 1,60,000 deaths annually since the 1970s. The IPCC stated that “climate change poses substantial risks to human health in Asia.” In fact, “there is already evidence of widespread damage to human health by urban air quality and enhanced climate variability,” for example. The shrinking of glaciers and rising sea levels are already being observed.

**What will the health sector do?**

Fortunately, much of the health risk is avoidable through existing health programmes and interventions. Concerted action to strengthen key features of health systems, and to promote healthy development choices, can enhance public health now as well as reduce vulnerability to future climate change.

WHO considers that rapid climate change poses substantial risks to human health, particularly among the poorest populations.

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**The Human Rights Implications of Climate Change**

Mr Laurent Meillan, Human Rights Advisor from the UN Resident Coordinator Office, Male, Maldives

The very real and very extensive human rights implications of climate change—and the equally real and extensive rights-based solutions that will be required in coming years as adaptation becomes ever more necessary—have been less emphasized to date in approaches to the climate change issue. While displacement caused by rising sea levels may be the most obvious and blatant human rights concern when looking at the human rights implications of climate change, many of the other human rights concerns also arise. These include the right to health due to changes in exposure to thermal extremes (heat and cold); increases in extreme weather events (floods, cyclones, storms, droughts); and increased production of certain air pollutants and aeroallergens (spores and moulds).

An integrated approach to climate change demands that human rights and adaptation strategies be pursued hand-in-hand, and only in so doing can we hope for the best of all possible outcomes. The leading role played to date by the Maldives on these issues is to be applauded.

The Government of the Maldives has recently engaged in efforts in Geneva to sponsor a resolution by the UN Human Rights Council on human rights and climate change. The resolution—which was adopted by consensus at the end of March 2008—requests that a formal study on these issues be carried out by the Office of the High Commissioner for Human Rights (OHCHR) in 2008, which will then be discussed in March 2009. This is an
The organization supports action to reduce human-induced changes in the climate.

Mitigation policies can produce direct health benefits. Well-designed urban transport systems can reduce greenhouse gas emissions and the health effects of urban air pollution at the same time; efficient home insulation can reduce consumption as well as reduce deaths from both cold and heat, and in poor countries, reduce the need for burning of biomass fuels and the impacts of indoor air pollution.

WHO also recognizes that, given past emissions of greenhouse gases, the world will continue to be faced with a warming and more variable climate for at least several decades.

WHO’s work in supporting programmes to combat infectious disease, improve water and sanitation services and respond to natural disasters helps to reduce health vulnerability to future climate change.

The organization also works directly to build capacity to adapt to climate change. This includes workshops in the most vulnerable countries to raise awareness of the health implications of climate change and related weather patterns, and to support intersectoral policies to reduce health vulnerability now. Such activities aim at improving health conditions today, while also laying the ground for more adaptation measures to climate change in the future.

Climate Change

important first step and hopefully symbolizes the beginning of a much more intensive and long-term process whereby all of the UN’s various agencies are drawn deeper into the climate change discussion. More important than that, it encourages the development of the strategies and capacities required to assist governments that are unable on their own to guarantee the protection of human rights for those affected by climate change.
World Health Day 2008 was observed in all 11 countries of the South-East Region. The theme was “Protecting health from climate change.” The events drew the attention of the public as well as of the health sector to this pressing issue. Selected activities in Member countries are summarized below.

In **Bhutan**, there were activities in the Capital as well as in all the 19 other districts. In Thimphu, very senior officials and decision-makers from the Government, collaborating partners, the private sector and senior school youths were involved. School students exhibited essays they had written on climate change, and the winning essay was read out. There was also a tree-planting, health runs and other activities. In the evening, a live panel discussion on “Climate Change and Health” took place on Bhutan Broadcasting Services with senior officials, including from the National Environment Commission and the Department of Public Health.

In **Bangladesh**, the official observance took place in Dhaka with high-level participation from the Ministry of Health and Family Welfare. A proposed Framework for a National Action Plan to Reduce the Health Burden from Climate Change in Bangladesh was produced by a workshop on climate change and health in November 2007, organized by the Directorate General of Health Services and WHO. On World Health Day 2008, a special television talk show on the subject of climate change and health was broadcast, and a special round-table brainstorming session was held involving many experts. Four Bangladesh nursing colleges observed the day.
with scientific seminars. Soon to be published is a climate change booklet that will contain the eight WHO-SEARO fact sheets translated into Bangla, as well as a background paper outlining the linkages between climate change and health in Bangladesh, and the Framework for a National Action Plan. In addition, five divisional-level seminars on climate change and health will be held during 2008.

In **DPR Korea**, the Ministry of Public Health and WHO in collaboration organized activities in the country’s 12 provinces. This included articles on the theme in five major newspapers and other newspapers at all levels, as well as television and radio broadcasts. World Health Day events were held at all provincial health motivation halls. The Central Level Celebration was organized in Pyongyang, and many institutions and ministries participated. The function also drew participants from many diplomatic missions and heads of UN agencies. Three health lectures were given, on “Protecting health from climate change,” “Impact of yellow dust on health and countermeasures” and “Impact of global warming on health.”

In **India**, public service announcements (PSAs) were aired in 11 regional languages as well Hindi and English from 28 stations. The PSAs focused on climate change outcomes (such as water scarcity and floods) and the harm caused to the environment by human activities. The Impact of Global Warming on Health was the subject of a talk-show on the Delhi station of All India Radio, and many listeners called in. WHO-India had collaborated with the Health Fitness Trust, New Delhi to organize a month-long health campaign that culminated on World Health Day. There was also a children’s poster competition. Sixty of the most creative posters formed part of a photo exhibit for the main event.
In **Myanmar**, an official commemoration ceremony was organized by the Ministry of Health. An exhibition was mounted of photographs, educational materials, posters and health statistics emphasizing the impact of climate change. Television and radio discussion shows were broadcast on Myanmar TV and Radio Myanmar. The World Health Day theme was broadcast in eight different languages. Public information announcements and articles appeared in newspapers, journals, and magazines. A World Health Day magazine was also produced by the Ministry of Health, highlighting articles on health and climate change. World Health Day ceremonies were also carried out at the state and division levels.

In **Indonesia**, World Health Day 2008 was observed with different activities by government and NGOs over a period of a month or so. Fact sheets on climate change and human health from WHO-SEARO were translated and printed in Bahasa Indonesia and distributed in various public functions. Several television talk show programmes on specific health risks and diseases related to climate change were organized through some of the country’s television services. The Ministry of Health organized a national seminar on the theme of protecting health from climate change on 7 April. Two open public activities of around three hours were organized. The Heart Foundation Indonesia, a national NGO, led the organizing of an event in National Monument Park with more than 5 000 participants; it was followed by a mass aerobic exercise and a tree planting.
In **Nepal**, a programme was organized to celebrate World Health Day at the National Health Training Centre, Department of Health Services (DHS) in Teku on 7 April by the National Health Education and Information Communication Centre (NHEICC), focal point of the Ministry of Health and Population (MoH&P)/DHS. Senior officials were present from several ministries and institutions, as well as WHO staff, development partners and the media. Presentations covered such subjects as future climate change and human health in Nepal, observed climate change and projections. Television and radio also carried advocacy messages and information related to the theme of climate change and human health.

In **Maldives**, the Official World Health Day meeting was conducted in the Education Centre, Kurendhoo Island. The significance of climate change for Maldives was discussed, including the risk posed by sea level rise and the need for coordinated, collective work to address health issues. Other activities to mark the day included a tree planting to help stop soil erosion in coastal areas, which about 500 people attended. Four hundred people participated in a rally and procession to publicize the theme of climate change. There was also a health fair, a workshop on changes in the environment and resulting health related manifestations, sporting events at which advocacy materials were distributed to spectators, a poster competition for school students and a stage show with music which incorporated health messages.
In **Sri Lanka**, World Health Day paper supplements were published on 7 April in three national newspapers in the main languages (Sinhala, Tamil and English). Facts about climate change and actions to be taken to protect health from climate change were highlighted. An Advocacy Seminar was held on the day as the main technical programme. The participants were the regional epidemiologists, consultant community physicians in charge of public health, health education officers and supervising public health inspectors from different regions and provinces. Two video messages were also televised. A poster competition was also launched; the award ceremony will be held in June, which will keep up the momentum created by World Health Day and serve as a follow-up activity.

In **Thailand**, the WHO Country Office kicked off the World Health Day 2008 celebration with an exhibition at the United Nations Conference Centre. The exhibition was held with other UN agencies as part of the UN Climate Change Talk that took place in Bangkok between 31 March and 4 April. On April 2, Thailand’s Ministry of Public Health, with the support of the country office, held another exhibition at the ministry compound to celebrate the occasion. An impromptu press conference was also held, as well as television interviews. The Ministry of Public Health held an evening reception to celebrate World Health Day 2008, which was attended by the public health minister, members of the UN family and of the diplomatic corps.

In **Timor-Leste**, the Ministry of Health, WHO and development partners celebrated World Health Day on 7 April 2008 in all 65 Community Health Centers in Timor-Leste.
This was the first celebration of World Health Day held outside the capital city, Dili, and in the 65 subdistricts of the country. It was also an occasion for the MoH to inaugurate the fourth referral Hospital in Oecussi district, which will provide health care services. Other activities included a one-day clean-up to remove mosquito breeding sites for epidemic potential diseases, such as dengue and malaria; community awareness programmes; TV and radio shows; translation of SEARO’s posters into Tetum and display during the national celebration; press releases in national newspapers; and promoting environmentally friendly approaches by symbolically planting trees.

Climate Change and Its Potential Impact on Vector-borne Diseases

Dr. J P Narain, Director, Communicable Diseases, SEARO

Climate change is an evolving concern that has captured the imagination of the international community. Although there are enormous uncertainties, there is overwhelming evidence that climate change will have a major impact on human health*.

Changes in weather obviously will have a direct impact on health in terms of greater morbidity and mortality resulting from heat stroke, skin/eye diseases and floods and storms leading to disease and injury. But there will also be other, indirect effects in the form of higher incidence of infectious diseases—in particular vector-borne diseases (VBDs), waterborne diseases, and zoonotic diseases. Altered food productivity will lead to malnutrition, hunger and decreased

*See tve.org/earthreport.
child growth and development, which in turn will have its effects on the social and demographic impact such as population migration. Unfortunately, the poor and the most vulnerable populations will bear the brunt as they usually are the main victims and have the least ability to adapt.

**Potential impact on vector-borne diseases:**

**The evidence**

The following three facts are important to understand the mechanism of how vector-borne diseases can spread in the context of changes in weather patterns:

First, mosquitoes (the vector) are temperature sensitive; they can’t survive cold or hot temperatures and need an optimum temperature range of 20–30 degrees Celsius (and relative humidity of 55–80%) for development. For malaria transmission to occur, a minimum temperature average higher than 15 degrees for *Plasmodium vivax* and 19 degrees for *Plasmodium falciparum* is needed. The mosquito vectors cannot be sustained if the minimum temperature is less than 15 degrees Celsius or too high—say, more than 40 degrees Celsius.

This means that with increased temperatures due to climate change, many new geographic areas will have an environment that is conducive to mosquito breeding, and as a result the vectors and vector-borne diseases will move into such areas where they have not been reported before and where the human populations are susceptible because previously unexposed. These areas include northern areas of India, namely Uttarakhand, Punjab, Himachal and Jammu and Kashmir, as well as much of Europe and the United States.

Not only is malaria now found in higher elevations in central Africa; it also threatens cities such as Nairobi. There is evidence that the malaria vector (such as *Anopheles fluviatilis*) which has traditionally not been found above the elevation of 1 500 metres has now been seen in Kashmir and Bhutan at heights of 2 000 metres or more. The dengue vector, *Aedes egypti*, normally seen up to 500 metres, is now seen in Nepal at the height of 4 000 metres and in Darjeeling at 2 200 metres. As a possible consequence, dengue has been reported for the first time from Bhutan and Nepal in the past three years. While many factors have played a role—globalization, rapidity of air travel—in the geographical expansion of dengue fever, as well as explosive outbreaks, the role of climate change cannot be dismissed. More research is certainly needed to discern the relative impact of various causes. Recently, chikungunya spread from Africa to the Indian Ocean countries and then to India, Maldives, Sri Lanka and other countries of the SEA.
Region—in many countries, chikungunya re-emerged after an absence of 30 years or more. Some scientists fear that chikungunya or dengue may become endemic in much of Europe and North America!

Another important fact is that the mosquitoes that are responsible for spreading vector-borne diseases are temperature dependent; any rise in temperature or warming of the climate will contribute to: a) quicker maturation of parasite from egg to an adult—reducing the time it takes for the malaria-causing parasite to develop to maturity; and b) a faster rate of digestion of blood meal (and so, more frequent biting or feeding), leading to increased transmission.

Third, climate change will lead to increased precipitation or increased relative humidity levels; a good corelation between rainfall and malaria, dengue and similar vector-borne diseases is well known. For example, the epidemic of malaria in Rajasthan in 1994 was related to the El Niño phenomenon of excessive rainfall and flooding. Similarly, in Sri Lanka, malaria epidemics were significantly more prevalent during El Niño years. In Indonesia too, a clear corelation has been observed between rainfall and increased malaria incidence.

In summary, the global warming phenomenon can extend the geographic areas capable of sustaining transmission of VBDs. While at present 42 percent of the globe offers conditions that can sustain transmission of malaria, the percentage could rise to 60 percent with a global increase of a few degrees. In the past few years, worldwide incidence of malaria has quadrupled due to changes in land development and regional climate change. With climate change, the transmission window of malaria will vary from state to state or between zones. The pattern of the malaria mosquito also may change, as well as the seasonality of the disease.

The way forward

In charting an appropriate and comprehensive response, it is important to realize that while the health impact is considered serious, it is yet to be fully delineated. Therefore, evidence gathering is a critical priority. Indeed, the health argument has not been used more affectively for advocating for measures to combat climate change in the past due to lack of data. It is ironic that climate change will have disproportionate and severest impact on poor people of Africa and Asia—those who least contributed to climate change in the first place, and are also the least equipped to deal with it! Recognizing that climate change may seriously jeopardize ongoing health gains (i.e. MDGs), the health sector has a unique role to play. While mitigation or prevention of greenhouse gas emissions and other measures are everyone’s responsibility, what should be the specific response of the health sector? It is without a doubt in the area of “adaptation” or reducing the impact, particularly on the poor and vulnerable. This requires a broad multisectoral response, which must involve governments, NGOs, civil society and the private sector taking a lead role with the health sector. It means strengthening public infrastructure including early warning and response systems to be able to anticipate early and respond quickly to adverse health impacts associated with climate change.
Life is Affected by Changing Climate in Nepal

Mr Han Heijnen, Adviser Environment Health, WHO-Nepal

Early on in the debate about climate change, the Department of Hydrology and Meteorology of the Government of Nepal was engaged in analysing the climatic changes that were occurring in the country. In the last 30 years, the temperature in Nepal has been rising steadily, with an average increase of 1.8°C from 1975–2006. So far, the year 2006 was the warmest on record. There are differences between the climatic zones in the country, with more warmer days and nights occurring in the hills and the mountains. Rainfall has increased slightly in the same period, but more excessive 24-hour rainfall episodes have been noted, as well as an increase of the number of days with heavy rainfall.

Already, people have been noting the change. In the mountain district of Mustang—a dry, windswept area—people have been experiencing more rainfall, which causes damage to their traditional mudblock houses, and higher temperatures, allowing them to grow bigger and tastier apples. Farming of cabbage, cauliflower, cucumber, chili and tomato has also become more successful at higher altitudes. At the same time, grasslands seem to be less productive due to lack of snow deposits, causing moisture deficiency, and the treeline is moving up (to higher altitudes).

Increased water-induced disasters

This is one of the most important consequences of the changes in climate. In the last decade, the number of floods and other water-induced disasters seems to have risen. National reports for the last four years show serious problems in many districts during the monsoon rains in July and August. In 2004, WHO reported that heavy rain in July caused “moderate to severe floods and landslides in 24 districts... There are 11 districts, which are severely affected in terms of deaths, displaced/affected families and population, disruption of infrastructure/land/agricultural damage” (Health Updates, 28 July 2004). In 2006, heavy rains in the third week in August caused “widespread flooding and landslides” in which 47 persons lost their lives, hundreds were unaccounted for and over 5 000 persons were evacuated and temporarily resettled. In all, “tens of thousands” were affected (Nepal Red Cross Society, Flood/Landslide Response Operation-2006, August 30, 2006). The following year, the Nepal Red Cross reported “96 people dead, 2 missing, 55 injured, 20816 displaced families and 337 241 people affected.”
A recent national workshop on Climate Change and Human Health, organized by the Nepal Health Research Council (NHRC), concluded that there were quite a few areas that urgently deserve attention with respect to health risk assessment and proposals for adaptation.

Currently, we do not have an exact idea how vector-borne diseases, such as malaria and Japanese Encephalitis (JE), will spread with the prevalence of a warmer climate in the hills. But transmission of JE was recently confirmed in Kathmandu (Partridge et al., Am. J. Trop. Hyg. 77(6), 2007) Transmission of dengue is also confirmed in townships in the terai (EDCD, 2007).

Changes in habitat, brought about by changes in climate and human settlement patterns in the terai, will bring about changes in the geographical spread of some vector-borne diseases.

The effects of climate change on agriculture and on water resources availability throughout the year and in certain drainage areas in the three climatic zones of Nepal will further determine how well communities can survive. Adaptation to the changing conditions needs to be developed and piloted.

NHRC is developing a multidisciplinary study framework during 2008 to collect and analyse the effects of climate change on human health and propose adaptation measures in consultation with all development sectors.
The super-cyclone Sidr hit the southern districts of Bangladesh on 15 November 2007, killing several thousand and affecting around 8.5 million people. Coming the same week as the release of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, it led many to wonder, was this event due to climate change? It would be difficult to draw a conclusion either way, given that Sidr occurred during the cyclone season and that super-cyclones are not aberrant events in this part of the world.

The IPCC has boldly projected the following scenarios for Asia:

- By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease.
- Coastal areas, especially heavily populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers.
- Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle.

This is mainly the long-term view—but how will these projections play out yearly through every monsoon season for emergency managers, health workers and the farmers and fisherfolk who have to face these conditions? Several scenarios and issues come to mind:

- Floods during the monsoon season will be worse in one year, and we can also expect floods outside the monsoon season in another year.
- Instead of a rainy monsoon season, there can be drought even during the rainy season.
- We may also see hotter summers and cooler winters.
- Cyclones can be as devastating as the recent cyclone Sidr or occur outside the expected periods.

Since 2005, scientists have been debating whether changing patterns of tropical cyclones are due to global warming. Many scientists have made statements that this link is difficult to ascertain.

In February 2006, leading scientists provided an expert view of the current state...
of knowledge regarding the link between hurricanes and climate change. With regard to the recent tropical cyclone seasons and the variability they conclude: “No single high impact tropical cyclone event of 2004 and 2005 can be directly attributed to global warming, though there may be an impact on the group as a whole.”

Most recently, however, evidence has pointed in a different direction. In its recent report the IPCC states that indeed there is observational evidence of an increase in intense tropical cyclone activity in the North Atlantic since about 1970, with limited evidence of increases elsewhere. There is no clear trend in the annual numbers of tropical cyclones. It is difficult to ascertain longer-term trends in cyclone activity, particularly prior to 1970.

Many factors influence tropical cyclone behaviour, but three factors must be present for them to intensify:

- Warm ocean temperatures (hurricanes can occur when surface ocean temperatures exceed about 79 degrees Fahrenheit (26 degrees Celsius))
- Low vertical wind shear (i.e. no strong change in wind speed or direction between two different altitudes)
- High humidity

As warm, moist air rises, it lowers air pressure at sea level and draws surrounding air inward and upward in a rotating pattern. As the water vapor–laden air spirals in and rises to higher altitudes, it cools and releases heat as it condenses into rain. This cycle of evaporation and condensation brings the ocean’s heat energy into the vortex, powering the storm.

In all this, climate change plays a role in intensifying cyclones. Two factors that contribute to more intense tropical cyclones—ocean heat content and water vapor—have both increased over the past several decades. This is primarily due to human activities that have significantly elevated carbon dioxide (CO₂) levels in the atmosphere. CO₂ and other heat-trapping gases act like an insulating blanket that warms the land and ocean and increases evaporation. And indeed, several other studies link intensification of cyclones to a warmer world.

In any case, climatologists and other scientists can only present a range of possible effects of climate change. The evidence does not help us to be more precise about what will happen, where and when it will happen.

This presents difficulties for disaster and emergency managers, for whom scenarios

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are crucial for preparedness and planning. Standard procedure is to prepare a comprehensive analysis of vulnerabilities, hazards and risks prior to planning. What throws off this current discipline is that with climate change, trends are subtle and pattern changes may not be obvious as we deal with them year in, year out.

This then is the crux of the issue in preparing for events with regular hazard return (e.g. yearly monsoon and cyclone seasons) or sudden events such as cyclones. Because of climate change, the health sector needs to prepare for a larger range of possibilities, taking into account the scenarios already mentioned:

♦ Do we stock more medical supplies prior to monsoons in the eventuality of a longer rainy season?
♦ Do we also prepare for a scenario of drought, in view of the possibility that not all areas of a country will receive a similar amount of rainfall? The public health priorities will certainly be different in that case.
♦ Will there be annual super-cyclones? If so, will our health facilities be able to withstand such strong winds and rain?

Public health priorities change in these scenarios, and preparedness has to be geared to accommodate this wider range. The basics of health surveillance—a strong health system providing effective primary and secondary prevention, and access to water and sanitation facilities prior to any event—will always be the best investment.

Strategies to cope with such uncertainties lie in adaptation, mitigation and risk reduction. We will have to prepare far, far in advance so that lives are spared from extreme weather events like Sidr. The IPCC suggests:

♦ For the infrastructure sector: Support relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural barriers.
♦ For the health sector: Heat-health action plans; emergency medical services; improved climate-sensitive disease surveillance and control; safe water and improved sanitation.

Several other suggestions for other sectors are provided by the IPCC report; what is needed is to link the possible climate scenario, adaptive strategy and policy and implementation. More important is how to get the message and the adaptive measures to the people who are most vulnerable to these extreme weather events and changes.

In summary, was Sidr caused by climate change? Probably not. But will future cyclones be like Sidr or worse, and come more often? Probably yes.

We have to widen our perspective and include the possibilities created by climate change. This makes for more effective preparedness, early warning and more important, appropriate risk reduction. This will conserve resources in our response—and also save lives.
Water, Climate and Human Health

More than 70% of our earth is covered by water, but of this only a mere 2.5% is fresh water—and less than 1% of the fresh water in the form of lakes, rivers, reservoirs and shallow underground water is accessible for direct human use. It is only this tiny amount that is renewed by rain and snowfall and is available on a sustainable basis.

Climate change and water supply

The IPCC technical report on climate change and water released in April 2008 states that observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences on human societies and ecosystems. Observed warming over several decades has been linked to changes in the large-scale hydrological cycle such as: increasing atmospheric water vapour content; changing precipitation patterns, intensity and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff. There have been significant decreases in water storage in mountain glaciers and Northern Hemisphere snow cover. Shifts in the amplitude and timing of runoff in glacier-
and snowmelt-fed rivers, and in ice-related phenomena in rivers and lakes, have been observed. These changes indicate alterations in the hydrological cycle that could have serious consequences for human health and livelihoods.

Increased precipitation intensity and variability is projected to increase the risks of flooding and drought in many areas. Water supplies stored in glaciers and snow cover are projected to decline in the course of this century, thus reducing water availability (through a seasonal shift in streamflow, an increase in the ratio of winter to annual flows, and reductions in low flows) in regions supplied by melt water from major mountain ranges, where more than one-sixth of the world population currently lives.

What does this mean for the South-East Asia Region?

Problems of water stress are already prevalent in the Region, driven by the increasing demands of domestic use, agriculture, industry and the growing population. Rapid urbanization, population explosion and haphazard development are the main causes for the increasing pressure on our vulnerable fresh water resources. Water stress has been aggravated with climate change.

About 80% of the population in the South-East Asia Region has access to improved drinking water supply. The water sources of the countries in our Region are mainly surface water such as rivers (fed by melt water from the Himalayas), underground water and springs (recharged with rainwater). The extreme weather events that are predicted to occur more frequently because of climate change will have a tremendous negative impact on the existing water supply systems. Coastal flooding, river flooding, droughts and changes in rainfall patterns will cause water quality problems through intrusion of sediments, human wastes and pesticides as well as by creating water scarcity. Also, events such as floods and tsunamis will destroy the existing water supply systems because these structures are not robust enough to withstand such disasters. Therefore, the Region will face a double burden of maintaining the existing systems against extreme weather events as well as trying to provide the remaining 20% of the population with improved water supplies. If adequate measures are not taken, these conditions will impede progress in realizing the Millenium Development Goals.

The expected rise in sea level caused by higher temperatures will cause greater problems for countries like Bangladesh, Indonesia and Maldives, where rising salinity of groundwater and estuaries is projected to decrease freshwater availability for humans.
Measures to cope with climate change

Some measures could be developed to cope with the effect of climate change on drinking water supply—such as empowering communities to use alternative options like rainwater harvesting during floods, treating water at the household level when quality deteriorates due to extreme weather events, building water systems that are resilient to floods, conservation of water, integrated water resource management among various water users (such as for drinking, irrigation, industries and power generation) and preparing emergency plans for water use during disasters. WHO has developed a water safety plan framework which is found useful in addressing this issue.

We must remember that whatever measures we develop now will not be foolproof and will not be able to address all water quality and scarcity issues in the future unless the basic cause of climate change is dealt with by all of us as responsible citizens of the earth. Therefore, while we work towards developing adaptive measures, we must reduce greenhouse gas emissions in whatever ways possible and preserve the very small quantity of fresh water that is available on the planet for our future generations.