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Organization

Regional Office for South-East Asia

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PROTECTING HEALTH FROM CLIMATE CHANGE

How is CLIMATE CHANGE affecting Our HEALTH?

A Manual for Students and their Families



Photo credit: © Sai Poojitha, 12 Years Old Student

How is CLIMATE CHANGE affecting **Our HEALTH?** *A Manual for Students and their Families*



Artist: Chitra Lal, 13 years old, Student

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Any queries regarding this guide should be addressed to: sde@searo.who.int

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Contents

Introduction	iv
Climate Change in our Region.....	1
Impacts of Climate Change: How does it all relate to me?	9
What can we do to make a Difference?	15
Annexes	19
Word Search	20
Case Studies	21
Glossary	23

Introduction

Climate change is often associated with ecosystem destruction and disappearing species. This is all true, but climate change affects our lives in a more direct way: our health. Unfortunately, the impact of climate change on human health isn't generally acknowledged. The fact that human-made changes in climate affect human health, in an indirect or direct way, needs to be disseminated among our communities, particularly among the youth who hold in their hands the power to change the future.

This manual is an attempt to sensitize growing adults about the importance of the linkages between climate change and human health. The students will learn the reasons behind the changes going on, how they affect each one of us in one way or other, the current and future effects and how we can respond to them. The complete resource material consists of two manuals: one for teachers and one for students.

The teachers' manual is a training resource to support spreading the information via interactive classroom activities. The student's manual is for them to take home, study and share information about climate change and its impact on human health with their families.

The manuals were field tested with 300 children and 15 teachers in several schools before printing of the final version. WHO wishes to thank all those who collaborated in developing the manuals, notably Paula Alvarado, Angela Rey, Dr. Jonathan Patz, Dr. Jenny Pronczuk and Dr. Andy Reisinger.

1

Climate Change in Our Region

Did you know that...?

- Eighteen heatwaves were reported in India between 1980–1998. A heatwave in 1988 caused 1300 deaths, while another one in 2003 caused more than 3000.
- In 2001, heatwaves in Bangladesh caused deaths among metal workers and rickshaw pullers due to heat stroke.
- In 2005, there were floods in Rajasthan and droughts in northeast India.
- In 2006, Bhutan reported loss of life from more frequent flash floods and landslides due to melting of glaciers.
- In 2007, four monsoon depressions double the normal number caused severe floods in Bangladesh, India and Nepal causing death, loss of livelihood and displacement of millions.
- Twelve of the last thirteen years (1995–2007) rank among the warmest years since 1850. The years 1998, 2005–2007 were the warmest on record.
- The glaciers in the Himalayas, the “Water Towers of Asia”, are melting rapidly. They are receding at an average rate of 10 to 50 meters per year. The Himalayas contribute crucially to the water supply of 1.3 billion people, feeding into nine of Asia’s greatest rivers.
- The Sunderbans in Bangladesh and in India face threats from the rise in sea level. The Sunderbans are the only mangrove tiger habitat and they support the largest tiger population in the world.
- In 2001, over 45% of tourist resorts in the Maldives reported Beach Erosion. Tourism is a major source of revenue for Maldives.
- In Indonesia, cases of dengue fever have risen by close to 50% between 2006–2007, likely due to temperature increases during and after the annual rains.
- Indonesia’s Environment Minister said global warming was to blame for the devastating



Photo: Basuki; www.who.int/phe

floods that hit the capital Jakarta in November 2007, forcing thousands of people to flee homes.

It appears that the phenomenon of global warming is upon us all! What's happening?

We first need to realize that there is a difference between weather and climate.

- **Weather** consists of those meteorological events, such as rain, wind, and sunshine that can change day by day, even hour by hour.
- **Climate** is the average of all these events over a period of time, like a year or several years.

... and what is climate change?

Our planet's climate is always changing. In the past it has altered following natural causes but at the present the changes have accelerated as a result of human behavior.

Nowadays the term "climate change" is generally used when referring to changes in our climate, which have been identified as occurring since the beginning of the mid 19th century.

The major mechanism behind climate change is the increased "greenhouse effect", by which the Earth's atmosphere traps energy from the sun just like a greenhouse.

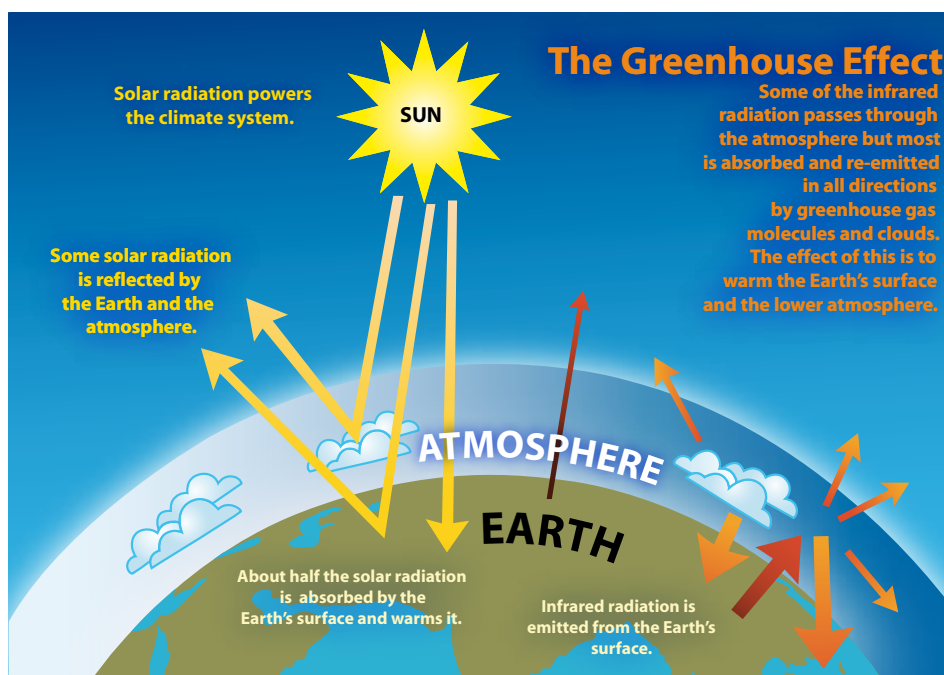
The natural greenhouse effect which warms our planet to support life—is being heavily disturbed.

The energy from the sun warms land, water, and air. In turn, the warmed-up land, water, and air give off heat, which rises up towards the sky. Gases, such as water vapor, present in the Earth's atmosphere capture some of that heat and prevent it from escaping into space. This heat trap keeps the Earth warm, and like a warm blanket makes our planet a habitable world for all the various animal and plant species to survive in.

Without this heat trapping system, the Earth's surface would be about 15 degrees Celsius colder than it is now.

This process is known as the **greenhouse effect**. It is a natural phenomenon mainly driven by water vapor, and other **greenhouse gases** (or **GHGs**) present in the atmosphere. Adding more greenhouse gases increases the warming effect to the point that it is no longer beneficial but has negative consequences for life on Earth.

Figure 1: The Greenhouse Effect



Source: www.global-greenhouse-warming.com/

Table 1: The six main greenhouse gases

Name	Description
Water vapor	Is one of the most abundant gases in the atmosphere and builds up with the evaporation from water bodies on Earth.
Carbon dioxide (CO ₂)	Is produced by the combustion of fossil fuels and from forest fires.
Methane (CH ₄)	Animal husbandry, irrigated agriculture and oil extraction release important amounts of this potent greenhouse gas.
Nitrous oxide (N ₂ O)	Is a by-product of burning fossil fuels and is also released when ploughing farm soils.
Ozone (O ₃)	Main element of the protective layer in the upper atmosphere, which shields the Earth from the sun's harmful ultraviolet radiation. Ozone is both a natural and a man-made gas. Produced in excess as a result of smog and severe air pollution, it becomes harmful to human health.
Chlorofluorocarbons (CFC _s)	Chlorine-containing gas used for refrigerators, air conditioners, aerosol spray propellants and cleaning agents. Chlorofluorocarbons cause depletion of the atmospheric ozone layer.

For over 10 000 years, the Earth has had relatively stable temperatures. But scientists have noticed that for the past 150 years our planet has been warming up fast.

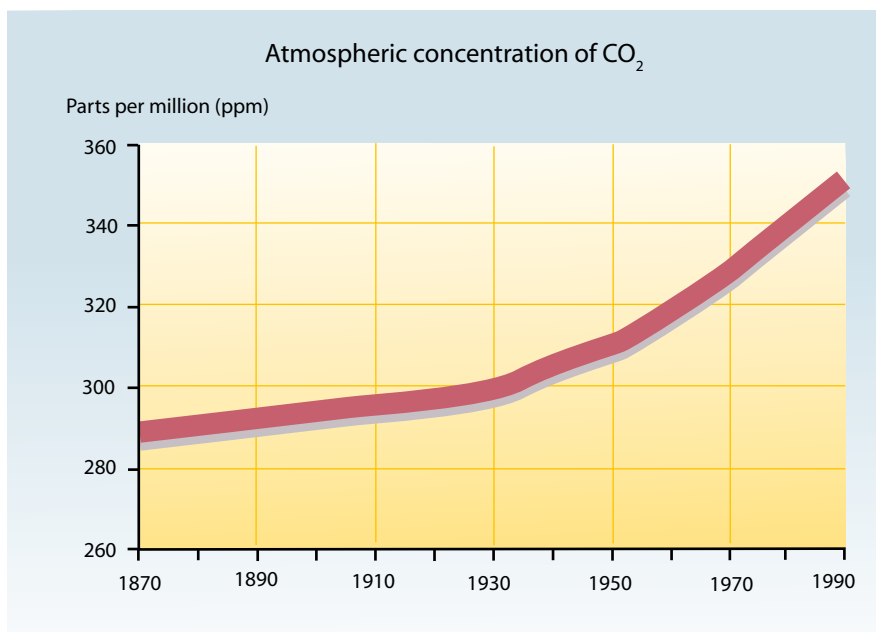
This phenomenon is called **“global warming”**. It is basically due to the increased amount of greenhouse gases in the atmosphere that have intensified the greenhouse effect. This change is the result of human activities that release GHGs.

Check it out for yourself! You can try this easy experiment at home: Take two jars and put a teaspoon of water in each

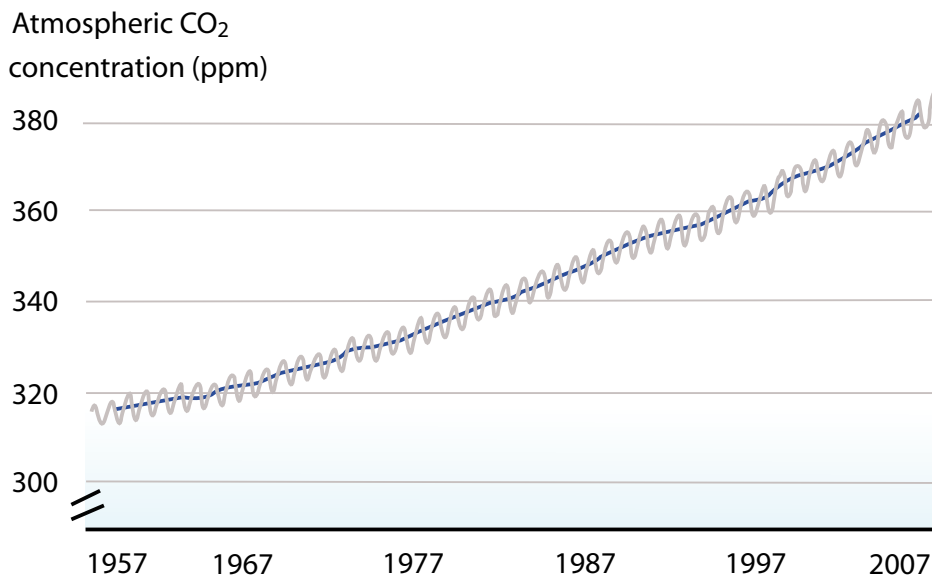
jar. Put a lid on just one jar. Place both jars in a sunny spot. After a few hours, check on the jars. You will see that the open jar hasn't changed, but the closed jar will be steamy and hot inside. What happened? The heat from the sun could not escape from the closed jar.

How do people produce the greenhouse gases?

Carbon dioxide (CO₂) is produced mainly in the burning of fossil fuels such as coal, oil and gas in industry, in

Figure 2: Atmospheric concentration of CO₂ between 1870 and 1990

Source: © UNEP/GRID-Arendal; http://maps.grida.no/go/graphic/global_atmospheric_concentration_of_co2_1870_1990

Figure 3: Atmospheric concentrations of carbon dioxide (CO₂) between 1957 and 2007

Source: © Hugo Ahlenius, UNEP/GRID-Arendal; <http://maps.grida.no/go/graphic/atmospheric-concentrations-of-carbon-dioxide-co2-mauna-loa-or-keeling-curve>

electricity generation, in transport and for heating purposes. In the incineration of waste, a great deal of carbon dioxide is released as well.

Methane (CH₄) is released mainly by cattle (digestive processes and manure), in waste treatment (fermentation on landfills), through leaks in the distribution of natural gas and in combustion processes.

Nitrous oxide (N₂O) or laughing gas, is released especially in the burning of fossil fuels (mainly in traffic), in a number of processes in the chemical industry and in agriculture.

Chlorofluorocarbons (CFCs) and similar substances and their substitute products (HCFCs and PFCs) are used chiefly as refrigerants, air conditioners, as propellants in aerosols and in the production of foam plastic.

Ozone (O₃) as such is not put into the atmosphere directly by man, but is generated there via a series of chemical reactions involving Nitrogen Oxides (NO_x), Carbon Monoxide (CO) and Volatile Organic Compounds (VOC). These ozone precursors, as they are called, are produced mainly by the transport and industrial sectors.

Urban settings are the biggest emitters of GHGs; they produce the maximum amount of industrial and car emissions.

Mega-cities produce a "**Heat Island Effect**". "Heat islands" refer mainly to urban settings where buildings and asphalt roads absorb and thereafter release more solar energy and thus increase the surrounding air and surface temperatures. Although they do not directly contribute to global warming this effect would increase the demands for air conditioning, thereby increasing the emissions of greenhouse gases.

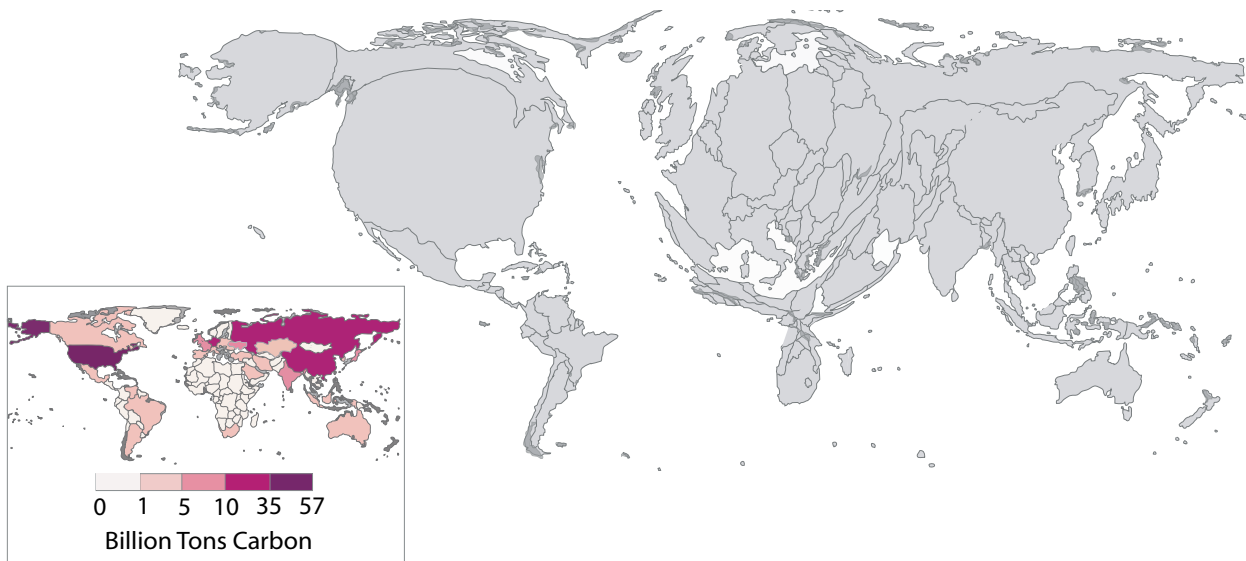
Some greenhouse gases occur naturally in the Earth's atmosphere. But scientists measuring the gases have found their amount has increased especially in the past few decades.

- Carbon dioxide (CO₂) is the most important human-generated (or "anthropogenic") GHG. Its annual emissions grew by about 80% between 1970–2004.
- The amount of CO₂ in the atmosphere reached 385 parts per million (or "ppm") in 2006, an unprecedented level in the past 650 000 years.
- The increase of GHG in the atmosphere is mainly human driven and is linked to the burning of fossil fuels such as coal or gas, but also due to forest fires.
- Scientists believe CO₂ levels will rise another 30% during the next 50 years.

Those countries that have historically contributed to global warming will not be the ones that will suffer the most from it. The two figures below show the unethical balance between emitters of GHG and victims of climate change.

The amount of CO₂ in the atmosphere grew by about 80% between 1970–2004.

Figure 4: WHO estimates of deaths per million people, attributable to the climate change that occurred from 1970s to 2000.



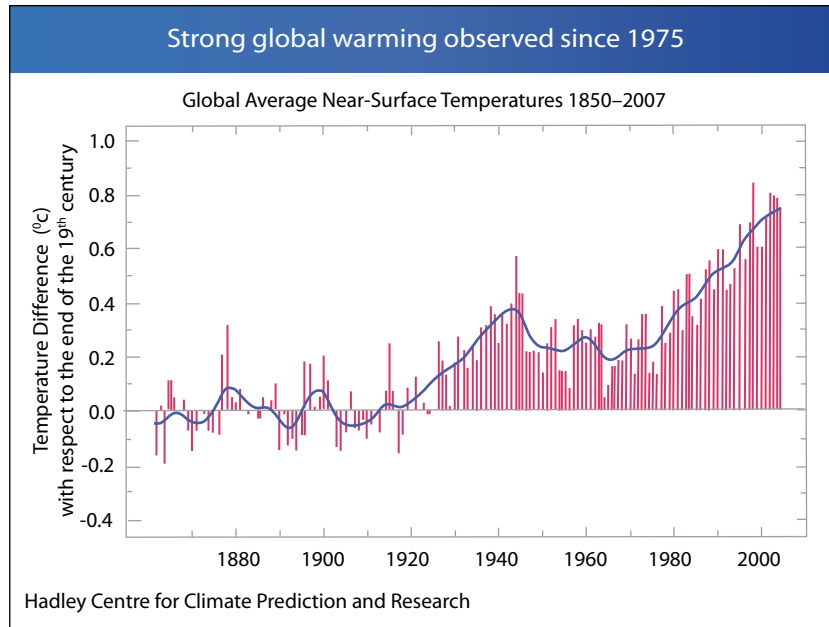
Source: Patz et al, Ecohealth, December 2007

Figure 5: Cumulative emissions of greenhouse gases



Source: Patz et al, Ecohealth, December 2007

Figure 6: Global average temperatures 1850–2007



Source: © British Crown Copyright 2008, the Met Office

Topics recap 1: What is climate change?

1. Create your own folder on climate change and human health! Collect newspaper articles or look up the web for recent information and news articles on climate change impacts in your region. You will be surprised how many there are! Save them for later reference.
2. Ask older members of your family what the weather was like when they were of your age, and compare it to today.
3. Explain the difference between weather and climate.
4. Why is the greenhouse effect so important?
5. Why is climate change also an ethical issue?
6. By how much has the concentration of CO₂ risen in the last 150 years?

The Intergovernmental Panel on Climate Change (IPCC)¹ was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its role is to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human induced climate change.

The Fourth Assessment Report of the IPCC, the result of 3 years of collaborative work by a group of 3600 scientific experts was released in 2007. Its findings state: *“Global atmospheric concentrations of CO₂, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.”*

- Because greenhouse gases trap heat, their increase is expected to raise the average global temperature by 0.2 degrees Celsius per decade over the next 100 years.
- Because GHGs are persistent, even if the concentrations of all greenhouse gases had been kept constant at year 2000 levels, a further warming of 0.1 degree Celsius of global temperature per decade would be expected. This may not seem much, but this is the same as the global average temperature rise that occurred over the last century.

Average global temperature is expected to rise by 0.2 degrees Celsius per decade over the next 100 years.

¹ www.ipcc.ch

A warmer atmosphere also disrupts wind and rain patterns leading to excessive floods and/or prolonged droughts.

As warmer seas expand, the sea level will rise, threatening residents along the coastlines and on low lying islands.



*Increasing sea-levels will lead to costal erosion
Photo: ©Greenpeace/Jeremy Sutton-Hibbert*

When sea level rises, it can do so for a few reasons. It can rise due to thermal expansion—the tendency of warm water to take up more space than cooler water. It can rise due to the addition of water, for instance from melting glaciers. It can also rise due to changes in salinity; fresh water is less dense than salt water and therefore takes up slightly more space than an equal mass of salt water. Relying on data from satellites and floats (mechanical devices drifting in the ocean), a group of oceanographers announced in June 2006 that sea level rose, on average, 3 millimeters (0.1 inches) per year between 1993 and 2005.

Warmer temperatures will also accelerate the melting of glaciers, leading to flash floods first, and to water shortages later.

The IPCC projections state:

“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 mega delta regions in South, East, and South-East Asia, will be at greatest risk due to increased flooding from the sea, and in some mega deltas, flooding from the rivers;*

...sea level rose, on average, 3 millimeters (0.1 inches) per year between 1993–2005.

- *Climate change is projected to compound the pressures on natural resources and the environment, associated with rapid urbanization, industrialization and economic development;*
- *Endemic morbidity² and mortality³ 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.”*

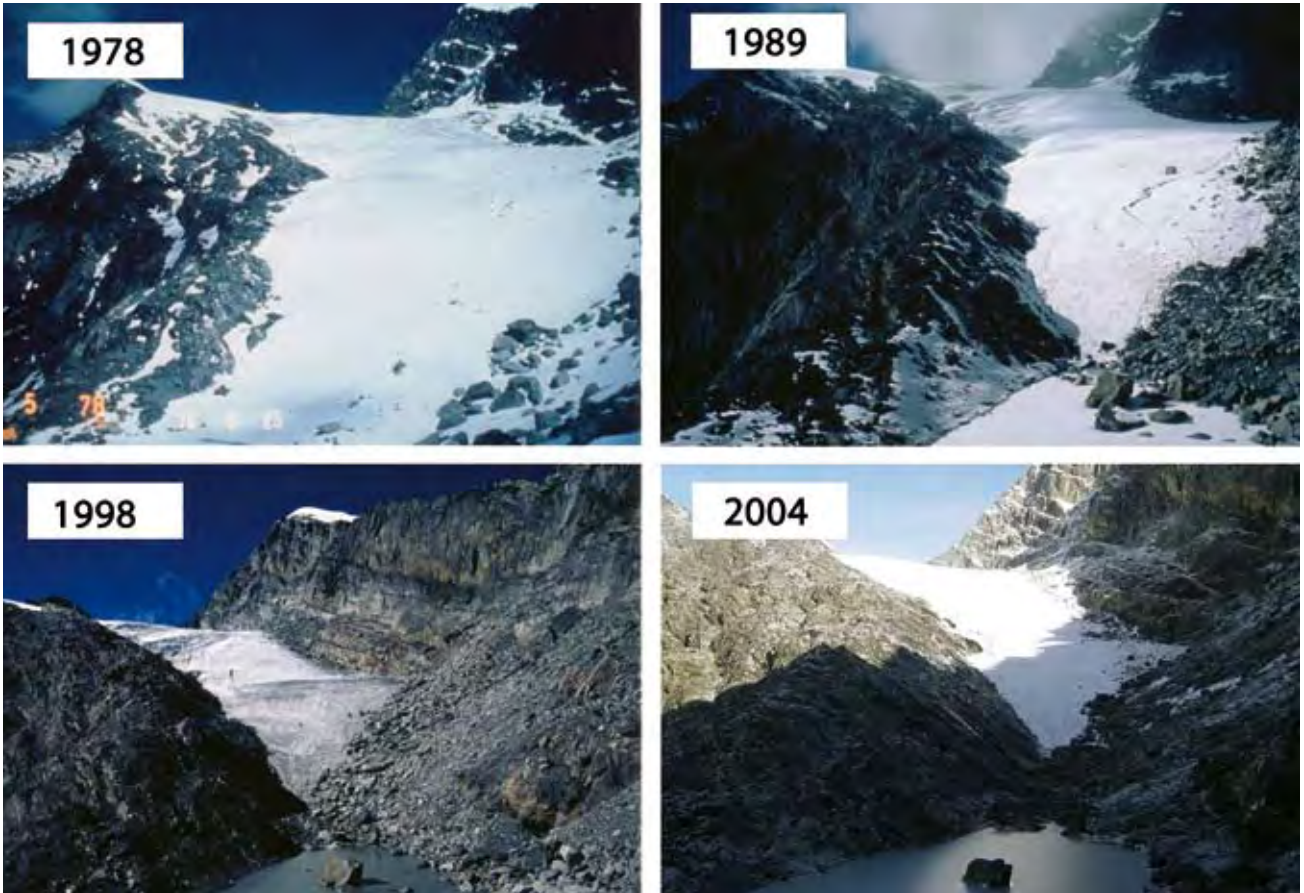
Topics recap 2: Global warming

1. Explain what global warming is.
2. By how much will the temperatures have increased by 2100?
3. Why does the sea level rise?
4. Name four natural events that will be accelerated because of global warming.
5. Study the statement of the IPCC and explain it in your own words.

² The morbidity rate is the number of cases of people with a disease in a population.

³ The mortality rate is the number of deaths in a population over a year.

Changes in the Glacier at Shrong Himal, Nepal over 26 years.



Source: Laboratory of Cryosphere Variation, Nagoya University <http://snowman.hyarc.nagoya-u.ac.jp>

2

Impacts of Climate Change: How does it all relate to me?

When we talk about global warming, the first picture that comes to our mind is generally of ecosystem destruction and loss of wildlife habitat... but, what about us, humans?

A lot of attention has been given to the impact of climate change on our environment, ecosystems and on various plant and animal species. However, climate change will also have major direct and indirect impacts on our health.

Indeed, the most recent report of the IPCC highlighted a wide range of implications for human health:

- Climate change can cause death and disease through natural disasters, such as heatwaves, floods and droughts.
- In addition, many important diseases are very sensitive to changing temperatures and precipitation. These include common diseases such as malaria and dengue fever; as well as other major killers such as malnutrition and diarrhoea.
- Climate change already contributes to the global burden of disease, and this contribution is expected to grow in the future.

The various potential health effects of climate change, both direct and indirect, are summarized in Table 2.



Photo: www.allposters.com



Photo: © Abir Abdullah / Still Pictures

In more detail: The climate change impacts on your health

Climate change will not only bring a warmer world, it is setting the scenario for an unhealthier one.

- **Heat strokes:** Higher temperatures are expected to increase the occurrence of heat-related illnesses such as heat exhaustion and heat stroke, and exacerbate existing conditions related to circulatory, respiratory and nervous-system problems. An increase in heat waves, particularly in urban areas, could significantly increase deaths. Higher overnight temperatures

during heat-waves are also a concern for human health, as cooler temperatures at night offer much-needed relief from the heat of the day.

- **Respiratory diseases:** There has been a sharp rise in the number of respiratory diseases. Key air pollutants, such as nitrogen dioxide and sulfur dioxide, worsen existing cardiovascular and lung diseases. The continued emissions of GHG will worsen air pollution levels.
- **Waterborne diseases:** Warmer temperatures will raise the risk of flooding, increasing diarrhoeal illnesses such as typhoid, cholera and other



Photo: © T. Balabaadkan UNEP/Still Pictures



Photo: © Deb Kushal -UNEP/Still Pictures

Table 2: Health concerns and vulnerabilities due to climate change	
Weather events	Impacts on human health
Warm spells, heatwaves and stagnant air masses	<ul style="list-style-type: none"> ◆ Heat stroke, affecting mainly children and the elderly. ◆ Increase in respiratory diseases. ◆ Cardio-vascular illnesses.
Warmer temperatures and disturbed rainfall patterns	<ul style="list-style-type: none"> ◆ More exposure to diseases like malaria, dengue, Japanese encephalitis and other diseases carried by vectors such as mosquitoes, rodents and ticks (known as "vectors". These diseases are therefore called vector-borne diseases.
Heavy precipitation events	<ul style="list-style-type: none"> ◆ Increased risk of diseases related to contaminated water (water-borne) and to unsafe food (food-borne). Depletion of safe water supplies and poor sanitation will increase the incidence of diarrhoeal diseases such as cholera.
Droughts	<ul style="list-style-type: none"> ◆ Malnutrition and starvation particularly affecting children's growth and development. ◆ Reduced crop yields causing stress for farmers and their families (known as "psychosocial stress"), who may be unable to pay their debts during extended and repeated droughts.
Intense weather events (cyclones, storms)	<ul style="list-style-type: none"> ◆ Loss of life, injuries, life long handicaps. ◆ Damaged public health infrastructure such as health centres, hospitals and clinics. ◆ Loss of life, loss of property and land, displacement and forced migration due to disasters will bring about psychosocial stress affecting mental health.
Sea level rise and coastal storms	<ul style="list-style-type: none"> ◆ Loss of livelihoods and disappearance of land will trigger massive migration and cause potential social conflicts, affecting mental health.

Source: WHO, 2007



Photo: © Abir Abdullah/Still Pictures



Photo: © Shehzad Noorani /Majority World / Still Pictures

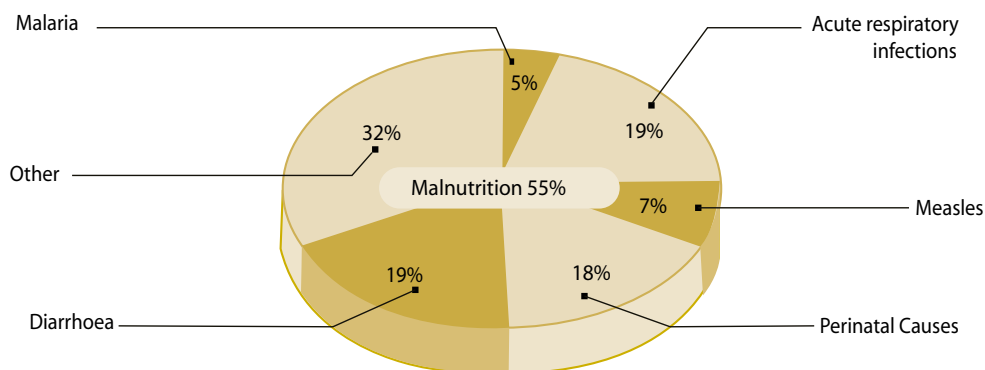
waterborne illnesses. Floods cause sewage and drinking water systems to mix, and that water if ingested can lead to diseases such as cholera, diarrhoea and typhoid. The lack of sanitation would make the problem worse.

- **Vector-borne diseases:** Climate change may increase the risk of some infectious diseases, particularly those diseases that appear in warm areas and are spread by mosquitoes and other insects. A change in climate will be more favorable to the growth of “vector organisms” like mosquitoes and rodents. These vector-borne diseases include malaria, dengue fever, yellow fever and encephalitis.
- **Malnutrition:** Food production would be severely affected by climate change, especially

cereal crops. A change in climate would change temperature, rainfall patterns, soil moisture and soil fertility. Crop pests could find ideal conditions to thrive. Food security problems would lead to widespread malnutrition. This would reduce child growth and development. Malnutrition and hunger would affect adults’ health too.

- **Injuries:** Changes in the frequency of extreme weather events such as heatwaves, cold spells, hurricanes, cyclones, floods and storms would result in injuries and deaths. The devastating impact of the 2007 floods in Nepal, Bangladesh and India and of the super-cyclone *Sidr* in Bangladesh killed over 4000 people and made millions homeless.

Figure 7: Malnutrition is the leading killer of children



**Malnutrition affects 54% of all children less than 5 years of age, and it makes them vulnerable to acute respiratory infections, diarrhoea, malaria and measles.*

Source: Adapted from WHO/FCH/CAH/00.40 [WHO Geneva, Department of Child and Adolescent Health and Development (CAH). Model chapter for textbooks-IMCI-Integrated Management of Childhood Illness], 2001



Floods in Andhra Pradesh in October 2005 killed over 120 people and injured many more.

Source: www.rmtbristol.org.uk

- **Psychosocial stress:** Natural disasters not only lead to destruction, but also to displacement. Survivors of such disasters have to cope not only with physical injuries, but the pain and stress of losing their family members, homes and livelihood. Witnessing such traumatic events could have a devastating

impact on their mental health—sometimes, forever. Climate change may also contribute to social disruption, economic decline and displacement of populations in certain regions due to effects on agricultural production, already-scarce water resources and extreme weather events.

Topics recap 3: Why should health be at the heart of climate change discussions?

1. Why do you think that little attention has been given to the impacts of climate change on human health?
2. How are respiratory illnesses related to global warming?
3. Which are the six main health impacts from climate change?
4. What are waterborne diseases and how do they relate to climate change?
5. Study the WHO graph on climate change and health linkages, and describe its contents in your own words.

PSYCHOSOCIAL FACTORS.



Climate
Change may lead to social, economic and humanitarian, injuries, malnu-

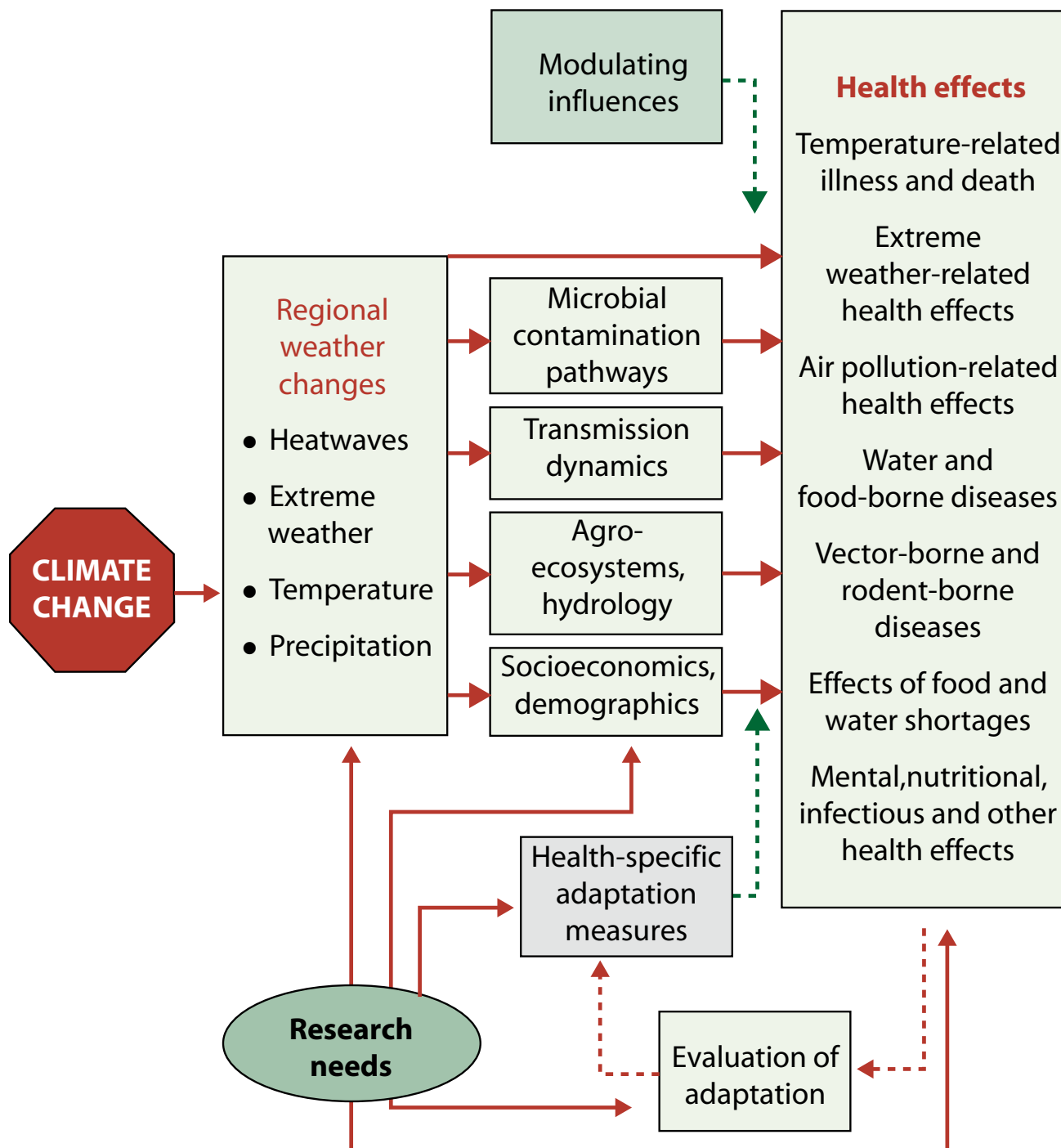
-trition. One of its major cause is Psychosocial Stress.

Many dangerous disasters have cope with traumatic events eg -

- (1) Deaths of persons.
- (2) Stressful injuries.
- (3) Losing their Family members.



Figure 8: Linkages between climate change and human health



Source: <http://www.who.int/globalchange/en/>

3

What can we do to make a Difference?

There are two basic ways to deal with the health problems of climate change:

- Reduce the causes of climate change and its consequences on human health—known as “mitigation”; and
- Improve the capacity to cope with the health risks by being better prepared—known as “adaptation”.

Examples of mitigation

Through encouraging personal action, we can do our part to dramatically reduce greenhouse gases and begin turning back the clock on climate change. We can make small but significant contributions towards preventing and reducing the effects of climate change simply by making a few changes in our daily lives. For example, some measures that will reduce our household GHGs emissions include:

1. Use AC and water coolers less.
2. Use low-energy light bulbs and switch them off when leaving the room.
3. Save water by not letting it run while brushing your teeth.
4. Turn off computers, TV and other appliances when not in use.
5. Improve insulation systems in our homes by designing our houses better.
6. Walk or cycle more—use the car less!
7. Use public transportation more often.
8. Share ride to school with friends and neighbors. It's also fun!
9. Implement the “Three Rs principle”: Reduce, Recycle, Re-use!
10. Home water purification treatments can prevent water borne diseases.
11. Sleeping in mosquito nets can protect us from being bitten by mosquitoes carrying diseases such as malaria and dengue. Fixing wire netting on windows, using mosquito repellent creams and wearing long-sleeved clothes and trousers are also useful in avoiding mosquitoes.

Mitigation: Any action taken to permanently eliminate or reduce the long-term risk to human life, property, and function from the hazards of climate change. Without good and early mitigation, the difficulty and costs of adaptation will grow rapidly.

Adaptation: An adjustment in behavior that responds to actual or expected climatic effects. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, public and private adaptation, and autonomous and planned adaptation. Successful adaptation builds on local knowledge, local capacity and willingness to act.

These are things you can do yourself. But to bring about a wider change in our society in relation to climate change it is important to involve communities around us. For example, we and our neighbors can get rid of sources of breeding sites of mosquitoes by encouraging people to fill in pools and puddles of stagnant water with sand and by asking local government and authorities to provide a good drainage system.

All countries have the responsibility to achieve the emissions targets set under the Kyoto Protocol. They are binding for those countries that have ratified this international agreement. The private sector has an obvious role to play in cutting greenhouse gas emissions by using more energy-efficient technologies that could dramatically reduce our dependence on fossil fuels. Plant-based “bio fuels” could represent an alternative as long as they don’t cause deforestation, threaten food supplies or make climate change even worse.

The health sector should emphasize the health benefits of reducing greenhouse gases by encouraging the use of public transportation such as rapid transport system which will reduce air pollution and decrease the rate of traffic injuries. Having cleaner air and leaving the car at home will also encourage more physical activity and thus reduce obesity.



Rapid Transport System

Examples of adaptation

Public health policies need to deal not only with the current burden of disease but also to take measures to reduce and prevent disease in the future. Improving the response to disease and surveillance is thus vital. 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 both enhance public health now and reduce vulnerability to future climate change.

Governments should actively work with local communities, notably in rural and remote areas to empower them with knowledge about local solutions to protect themselves from diseases. For instance, it is important for them to understand the need to have a system that ensures safe drinking water and to have the necessary knowledge to maintain it.

Other measures that reduce the negative impacts of climate change include the use of crop varieties with greater drought tolerance; adoption of irrigation methods that use less water or use it more efficiently and preparing for rising sea levels with better flood defenses and ensuring no settlements are in vulnerable areas.

Both adaptation and mitigation are needed (now) as effective response measures to climate change. **We need to “avoid the unmanageable and manage the unavoidable”.**

We can make small but significant contributions towards preventing and reducing the effects of climate change simply by making a few changes in our daily lives.

Case Study A: Most households in Bhutanese villages suffer from water scarcity during the dry season. Village elders tell that many rivers have dried out in recent time. In 2006-rooftop rainwater harvesting systems were provided to various communities. A reservoir tank with the capacity to hold enough water throughout the dry period, gutters and down pipes to channel water into the tank were given to each household by the government. The local community provided the labor for installation and was trained to ensure sustained operation and maintenance. These rooftop rainwater harvesting systems have changed lives and increased climate change resilience.



Case Study B: Sri Lankan children are observing mosquito larvae in water containers. They learn to identify the larvae of the various mosquitoes that breed in the paddy fields around their village. By understanding the life cycle of the disease vectors and the importance of environmental factors such as water and temperature, villagers become experts in Integrated Vector Management or IVM. IVM allows local communities to be better prepared to address the health impacts of climate change and to keep healthy.



Personal action

“A to Z” tips on what YOU can do NOW, to help reduce the adverse health impacts from climate change

Act Now!

Buy energy efficient appliances: Make informed choices. If you’re buying a washing machine, refrigerator, dish-washer or oven, buy the most energy-efficient model you can afford. They might be more expensive but they pay for themselves through lower energy bills. The same is true for procurement of office equipment, such as computers, photocopiers and printers.

Calculate your personal carbon footprint and cut your greenhouse gas emissions. See for example: 3w.earthday.net/footprint/info.asp or at <http://www.carbonfootprint.com/>

Debate, discuss, and distribute leaflets, brochures and posters on climate change and environmental health issues. Useful information is available at: 3w.unep.org/wed/2007/english/; <http://unfccc.int/>; 3w.who.int/globalchange/climate/en/index.html; www.climatecrisis.net/

Enjoy the sun! Fit solar panels on the roof of your home. Why not turn your home or office into a clean power station? Solar power is renewable and plentiful!

Fridge: Don’t leave fridge doors open for longer than necessary; let foods cool down fully before placing in the fridge or freezer; defrost regularly and keep the appliance at the right temperature. Where possible, don’t place cookers and fridges/freezers next to each other.

Go Green! If you have to buy a car, buy a fuel-efficient, environmentally friendly one. This will save you money and keep more CO₂ from going into the atmosphere. Make sure that your tires are inflated correctly—this can save you 5% on the cost of your petrol. Share car journeys with your work colleagues or friends. Make more use of public transport, such as the metro, and the train for longer journeys. For short trips and local shopping, try walking or use a bicycle. It keeps you fit and is fun too! More at: 3w.worldwildlife.org/climate/involved/individuals.cfm

Halve your emissions by moving your air conditioner thermostat up by 5 degrees Celsius in summer. Almost half of the energy we use in our homes goes to cooling.

Maintain the filters on your air conditioners by cleaning them regularly. A clean air filter can save pounds of carbon dioxide a year. More at: 3w.greenpeace.org/international/campaigns/climate-change/take_action

Involve your family, friends, children and neighbors!

Join an environmental group. Find out what action groups are doing around your locality or region; if there are no groups, start one!

Kick start an environmental campaign in your neighborhood.

Lamps: Replace the bulbs you use most with compact fluorescent lamps or CFL bulbs. More information on CFL at: http://www.energystar.gov/index.cfm?c=cfls.pr_cfls

Minimize the use of toxic chemicals. Use non-toxic, biodegradable, water- or plant-based paints, cleaners and pest repellents.

Network with specialized agencies, non-profit organizations and engaged communities. More at: http://www.cseindia.org/html/eyou/climate/index_climate.htm

Offset your carbon footprint. There are many cost-effective energy saving and carbon reducing steps anyone can take. See more at: <http://www.carbonfund.org/>

Plant trees: The United Nations Environment Programme (UNEP) has launched a major worldwide tree planting campaign, aiming at planting one billion trees around the globe. <http://www.unep.org/billiontreecampaign/>

Quit using plastic bags. Carry your own bag with you when going shopping.

Recycle, repair and reuse materials. Tips, tricks and ideas for sustainable living. See: www.ban.org/main/marketplace.html; www.geda.org.in/e_conserv/ec_ov_tds.htm; <http://www.regeneration.org/tips-downloads/>

Save paper: Print on both sides of the paper. Proofread documents on screen before printing. Instead of making a copy for each person, route one copy around. Do not discard one-sided printed pages; use them to make scratch pads.

Turn off televisions, videos, stereos and computers when they are not in use—they can consume between

10 and 60% of the power when in “stand-by” mode. Turn off computer screens and photocopiers when you take a break. Also turn off lights when you don’t need them,— it saves energy after a minute or two. Unplug electronic items when you’re not using them.

Use less energy, and conserve more of it! Do not waste water—close your tap while brushing your teeth, and while soaping clothes, body or dishes. Repair leaky plumbing fixtures; prevent overflowing of tanks. Energy is used for pumping and treating water. Save water to save energy!

Value wastes! Do not dump your home wastes everywhere. Heaps of garbage left in the open emit methane and contribute to global warming. Segregate your wastes so they can be recycled and/or reused and where possible use organic waste for composting.

Write letters about the health impacts of climate change to the local newspapers. This is a great way to keep the issue in the public mind. It also sparks a debate and allows us all to understand what the real issues are.

Express your concerns on environmental health issues and solutions and stay informed. Read widely and understand what we are dealing with.

Your president, prime minister, parliamentarian or local leader needs to know about the impacts of climate change on health. Write letters to them asking for policies to ensure greenhouse gas emissions fall by at least 3% each year from now on.

Zoom in on reducing emissions: It is the best way forward! Our countries need new national legislation and laws to help ensure that we develop cleaner cars and cleaner power plants and to help us get government rebates on installing solar power, solar hot water, or wind power in our homes. See also: <http://www.climatecrisis.net/t>

Topics recap 4: Get Involved, now!

1. The most obvious step towards reducing the adverse impacts from climate change on human health is mitigation. Explain.
2. Adaptation to climate change is as important as mitigation. Explain why?
3. List 10 key actions that you are prepared to do to reduce your greenhouse gases emissions.

Annexes

Food for Thought (Answers on page 24)

1. In 2000, how many people, globally, have been estimated to die annually due to climate change?

a. 10 000	b. 20 000	c. 60 000	d. 160 000
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2. How many people could be made homeless due to global warming by the year 2050?

a. 5 million	b. 1 million	c. 150 million	d. 1 billion
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3. How many people in Asia could be facing a major water shortage if current rates of carbon emissions continue?

a. 1 million	b. 10 million	c. 50 million	d. 1 billion
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4. Which lighting option produces the least amount of greenhouse gases?

a. Candles	b. Compact fluorescent light bulbs	c. Normal light bulb
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5. If you turn your lights off when they are not in use you could save on average:

a. 10% of your energy bill	b. 8% of your energy bill	c. 15% of your energy bill
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Word Search

W	H	O	T	L	G	R	D	W	F
A	E	U	J	K	L	V	S	O	L
R	H	A	R	P	A	Q	S	L	O
M	Y	Z	T	R	C	S	Z	X	O
E	U	B	M	H	I	P	C	C	D
R	D	N	Z	L	E	C	O	L	S
S	I	L	F	M	R	R	A	B	I
M	S	U	F	C	S	H	S	N	S
A	E	X	E	Y	C	T	J	N	E
L	A	J	T	S	H	U	O	S	A
A	S	E	J	G	R	B	Z	L	R
R	E	R	U	I	R	Y	A	X	I
I	S	O	E	A	G	A	S	E	S
A	R	S	C	E	U	G	N	E	E
D	I	A	R	R	H	O	E	A	M
C	L	I	M	A	T	E	U	I	D
Q	U	F	W	R	P	U	T	W	S
T	F	T	G	E	B	I	Y	J	M
A	N	V	J	L	G	Y	R	F	R
E	S	L	E	A	U	P	Q	M	O
H	L	W	T	D	V	O	M	R	T
P	D	I	K	W	Q	U	F	K	S
L	O	Z	O	N	E	B	S	Z	J
N	R	I	E	L	S	E	R	I	F

Look for:

Fossil fuel	Droughts	Glaciers	Climate
Diarrhoea	Malaria	Storms	Diseases
Hurricane	Weather	Heat	Mitigation
Injuries	Floods	IPCC	WHO
Sea Rise	Warmer	Gases	Fires
UNFCC	Ozone	Carbon	Dengue

Case Studies

Case Study 1: Climate Change and Human Health: Responding to the new threat to global health security

The **Intergovernmental Panel on Climate Change (IPCC)** was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. It provides the decision-makers and others interested in climate change with an objective source of information about climate change. In 2007, IPCC has made the following projections for the next century:

- Global mean surface temperature will rise, as best estimates, by 1.8–4.0°C, depending on future greenhouse gas emissions. Warming will be greatest over land areas, and at high latitudes;
- The projected rate of warming is greater than anything humans have experienced in the last 10,000 years;
- The frequency of weather extremes is likely to change leading to an increased risk of floods and drought. There will be fewer cold spells but more heat waves;
- Patterns of rainfall are projected to change, with more rain in high latitudes but less rain in many subtropical regions; in some areas, rainfall could also change seasonally, with more rain projected during the wet monsoon season but less during the dry season;
- Global mean sea level is projected to rise by 18–59 cm by the year 2100, but could rise more if ice sheets (Greenland and Antarctica) melt faster than expected. Sea level will continue to rise further in coming centuries even if greenhouse gas emissions are reduced.

At the Twenty-fifth Meeting of Ministers of Health in 2007 (Thimphu, Bhutan) the most important health authorities in the South-East Asia Region concluded that climate change poses a major threat to health security, and requested World Health Organization (WHO) to “support the formulation of a regional strategy to combat the adverse health impacts of climate change”.

WHO is therefore supporting country programmes to combat infectious disease, improve water and sanitation services, respond to natural disasters, and is helping them

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 simultaneously laying the ground for more future adaptation measures to climate change.

Case Study 2: Bangladesh is paying a cruel price for the west’s excesses

By Veena Khaleque; December 7, 2006, The Guardian

Bangladesh is one of the world’s largest deltas, formed by a dense network of 230 unstable rivers; most of the country is less than 10 meters above sea level. It is also one of the poorest countries in the world. A low economic capacity, inadequate infrastructure and a higher dependence on a natural-resource base exacerbate its vulnerability. Climate change in Bangladesh will take form in floods, salinity intrusion and droughts, all of which will drastically affect crop productivity and food security. The last two decades have witnessed ever more frequent and intense flooding. In 2004, 38% of our country was ravaged by floods, which destroyed more than three quarters of crops, left 10 million people homeless, and in their wake diseases such as dysentery and diarrhoea. The poor are hit hardest by climate change, and poverty forces people to live in makeshift homes; when disaster strikes they have no way of rebuilding. Estimations are that were the Earth to warm by just one degree Celsius, 11% of Bangladesh would be submerged, putting the lives of 55 million people in danger. The recently published Bangladesh National Adaptation Programme of Action recommends strategies focusing on coastal forestation, provision of drinking water to coastal communities, education, the protection of urban infrastructure, and scientific research and development to protect crops.

Case Study 3: Bhutan to address adverse health impacts from climate change

Though Bhutan’s contribution to the total greenhouse gases responsible for global warming has been very small, or practically irrelevant, the country is currently facing adverse impacts from climate change.

- Since 2000, it reports unusually prolonged droughts, erratic rainfall patterns, and floods.
- At least 25 glacial lakes have been identified as posing a major risk of bursting, from excess glacial melt water, in the near future.
- According to the International Center for Integrated Mountain Development (ICIMOD) annual average glacial retreat of glaciers in the country has doubled from 20m to 40m since 1990.
- Two lakes are expected to burst in 2010 and extremely costly measures are needed to build spillways to protect the downstream riverside communities and ecosystems.
- Given that 80% of Bhutanese are subsistence farmers, climate change will have direct consequences on food security, health and livelihoods.

Case Study 4: UN Breakthrough on climate change reached in Bali

IPCC, Bali, 15th December 2007. Source: <http://unfccc.int/>

187 country representatives gathered in Bali last December and agreed to start negotiations towards a crucial, and strengthened, international climate change deal.

The decision includes a clear agenda for the key issues to be negotiated up to 2009. These are: action for adapting to the negative consequences of climate change, such as droughts and floods; ways to reduce greenhouse gas emissions; ways to widely deploy climate-friendly technologies; and financing both adaptation, and mitigation, measures.

Concluding negotiations in 2009 will ensure that the new deal can enter into force by 2013, following the expiration of the first phase of the Kyoto Protocol.

Indonesian Environment Minister and President of the conference Rachmat Witoelar said: "We now have a Bali

roadmap, we have an agenda and we have a deadline. But we also have a huge task ahead of us and the time to reach agreement is extremely short, so we need to move quickly," he added.

Earlier this year, the UN's Intergovernmental Panel on Climate Change (IPCC) declared that the world's average temperature, if left unchecked, could rise by as much as 6 degrees Centigrade by the end of the century, causing serious harm to economies, societies and ecosystems worldwide.

"This is a real breakthrough, a real opportunity for the international community to successfully fight climate change," said Yvo de Boer, Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC). "Parties have recognized the urgency of action on climate change, and have now provided the political response to what scientists have been telling us is needed," he added.

While a new global deal is expected by 2013, countries also agreed on a number of steps that need to be taken immediately to further implement the existing commitments of UNFCCC Parties. These issues are particularly important for developing countries.

The conference was attended by around 11 000 participants, among them the Secretary-General of the United Nations and six Heads of State.

Topics recap 5: Study of the annexes

1. What should be considered as priority actions to reduce adverse human health impacts of climate change?
2. Some say the issue of climate change is an ethical one. Explain why?
3. Has Bhutan initiated new programmes to address the challenges posed by climate change?
4. What were the main achievements at Bali in 2007?

Glossary

Adaptation: Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to an adjustment in behavior that responds to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, public and private adaptation, and autonomous and planned adaptation. Successful adaptation builds on local knowledge, local capacity and willingness to act.

Anthropogenic Climate Change: Anthropogenic means “human-made”. In the context of climate change it refers to greenhouse gases, or emissions that are produced as the result of human activities. These include fossil fuel burning for energy, deforestation and land use changes that result in net increase in emissions.

Atmosphere: The gaseous cover surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen and oxygen, together with a number of trace gases such as argon, helium and radiatively active greenhouse gases such as carbon dioxide, methane and ozone. In addition, the atmosphere contains water vapor, clouds, and aerosols.

Biofuels: Fuels made from cellulosic biomass resources. Biofuels include ethanol, biodiesel, and methanol. Replacing fossil fuels with biofuels for energy production could bring environmental and health benefits by lowering greenhouse gas emissions. But using land to produce biofuels essentially competes with using land for food production. Also converting rainforests, peatlands, savannas, or grasslands to produce food-based biofuels could release up to 420 times more CO₂ than the annual GHG reductions these biofuels provide by displacing fossil fuels.

Carbon Dioxide (CO₂): A naturally occurring gas as well as a by-product of burning fossil fuels and land-use changes and other industrial processes. It is the principal

greenhouse gas which affects the Earth’s radiative balance and the reference gas against which other greenhouse gases are measured. In March 2006, CO₂ levels stood at 381 parts per million (ppm)—100ppm above the pre-industrial average.

Carbon footprint is the measure of the amount of carbon dioxide or CO₂ emitted through the combustion of fossil fuels in carrying out a process or makes a product. The scope of a carbon footprint analysis can vary and may/ may not include all GHGs. When it includes all GHGs, the footprint is expressed as a “CO₂ equivalent units”. It is key for measuring the performance of the corporate sector. The carbon footprint for an individual reflects activities under her/his control—eg. home energy use, personal transport and consumption patterns.

Carbon Sink is the natural mechanism that removes carbon dioxide from the atmosphere, such as the absorption of carbon dioxide by growing trees and/or protecting existing forests.

Climate change: Refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere. The UNFCCC defines climate change as ‘*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*’.

El Niño: A term used to describe the extensive warming of the central and eastern Pacific that leads to a major shift in weather patterns across the Pacific. The 1997–98 El Niño had significant social and economic implications for Indonesia.

Greenhouse Effect: Natural and human made (anthropogenic) gases in the atmosphere that absorb and emit infrared or heat radiation, causing the greenhouse effect.

Greenhouse gases (GHGs): Those gases in the atmosphere which absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. Water vapor, carbon dioxide, nitrous oxide, methane and ozone are the primary greenhouse gases in the atmosphere. Methane warms the earth 23 times and nitrous oxide 296 times as much as the same mass of CO₂.

Global Warming: An increase in the average temperature of the earth's atmosphere, especially a sustained increase sufficient to cause climatic change.

Intergovernmental Panel on Climate Change (IPCC): A group of experts established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its role is to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change, based mainly on peer reviewed and published scientific/technical literature.

Kyoto Protocol/UNFCCC: The internationally binding agreement under the UNFCCC that set GHG targets for signatories to abide by. Drawn up in 1997 and came into effect in 2005, it requires developed countries to reduce emissions by 5 percent, compared with 1990 levels, by 2012. Most of the world's countries agreed to the Protocol, but some nations chose not to ratify it.

Mitigation: In the context of climate change, it is any action taken to permanently eliminate or reduce the

long-term risk to human life, property, and function from the hazards of climate change. Without good and early mitigation, the difficulty and costs of adaptation will grow rapidly.

National Adaptation Programmes of Action: NAPAs provide a process to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. The NAPA takes into account existing coping strategies at the grassroots level, and builds upon that to identify priority activities, rather than focusing on scenario-based modeling to assess future vulnerability and long-term policy at state level. In the NAPA process, prominence is given to community-level input as an important source of information, recognizing that grassroots communities are the main stakeholders.

UN Framework Convention on Climate Change (UNFCCC): Convention signed at United Nations Conference on Environment and Development in 1992. Governments that become Parties to the Convention agree to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

UNFCCC Nairobi Work Programme: The NWP is an international framework developed to help countries improve their understanding of climate change impacts and vulnerability and to increase their ability to make informed decisions on how to adapt successfully.

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.

Answers to "Food for Thought"

1. According to WHO an estimated total of 160 000 people died as a direct result of climate change. This is due to an increase in frequency of natural disasters such as heat waves and floods.
2. One billion people would be made homeless due to global warming by the year 2050.
3. In Central, South, East, and South-East Asia freshwater availability is projected to decrease, which along with population growth and increasing demand from higher standards of living, could adversely affect more than 1 billion people by the 2050s.
4. Fluorescent light bulbs are the most energy efficient, whereas candles when burnt release carbon dioxide directly.
5. If you turn your lights off when they are not in use you could save on average 10% of your energy bill.



**World Health
Organization**

Regional Office for South-East Asia

World Health Organization
Regional Office for South-East Asia
World Health House, Mahatma Gandhi Marg,
New Delhi 110 002
India

website: www.searo.who.int/World Health Day 2008

E-mail: sde@searo.who.int