Module -3

Sustaining Natural Resources and Environmental Quality

By

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Contents

- Environmental hazards: Biological, Chemical, Nuclear
- Risk and evaluation of hazards
- Types of pollution: Air and water
- Pollution sources, effects and mitigation
- Water quality management and its conservation;
- Water footprint and virtual water
- Solid waste management
- Climate disruption and ozone depletion (Kyoto protocol, Carbon sequestration methods and Montreal Protocol – can be discussed).

Environmental hazards

- Risk assessment is the scientific process of using statistical methods to estimate how much harm a particular hazard can cause to human health or to the environment.

Every day's risk

- Every day we face some risks
  - Driving or riding a car
  - Eating foods with high cholesterol- risk to heart attack.
  - Drinking alcohol.
  - Smoking
  - Enclosed place with smoker.
  - Tanning – sun's ray.
  - Skin cancer
  - Living in a hurricane –prone area.

Types of hazards

- **Biological Hazards:** more than 1,400 pathogens (bacteria, viruses, parasites, Protozoa, and fungi) can affect humans.
- **Chemical hazards**: harmful chemicals in air, water, soil, and food.
- **Physical hazards:** fire, earth quake, volcanic eruption, floods, storms.
- **Cultural hazards**: unsafe working conditions, unsafe highways.
- **Life style changes:** smoking, , drugs usage etc.

Biological hazards

- Disease can spread by following ways:
  - **Non-transmissible disease**: eg. Cancer, CVS disorders, asthma, emphysema, and malnutrition.
  - **Transmissible Disease**: disease can spread from one to another or by pathogens or parasites etc.

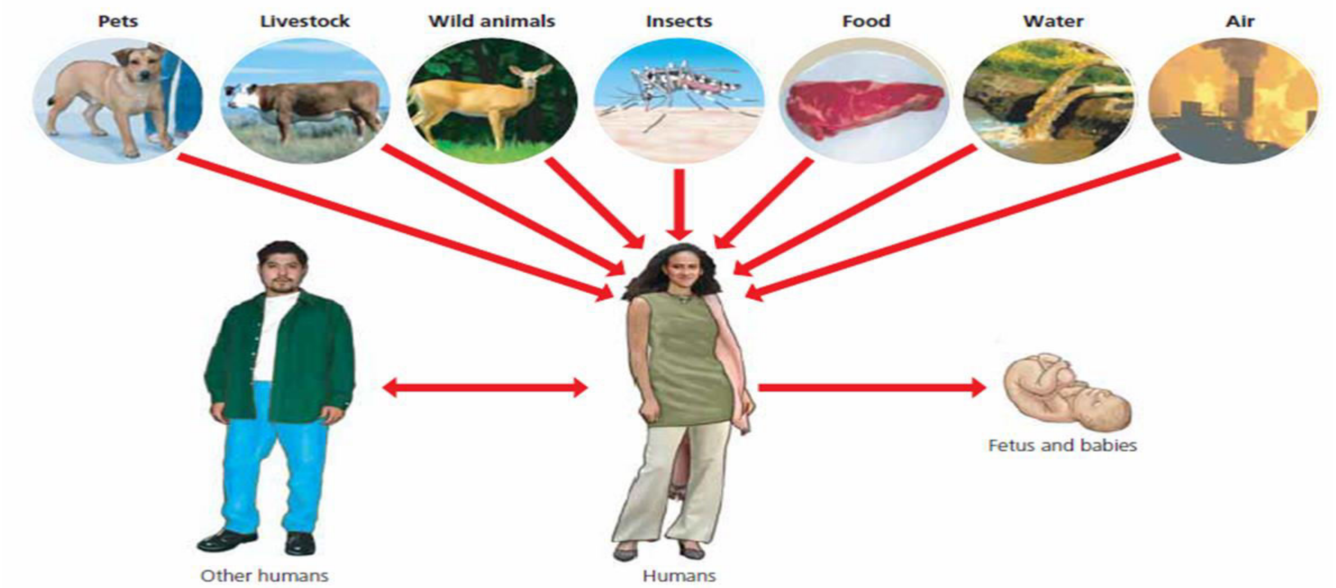
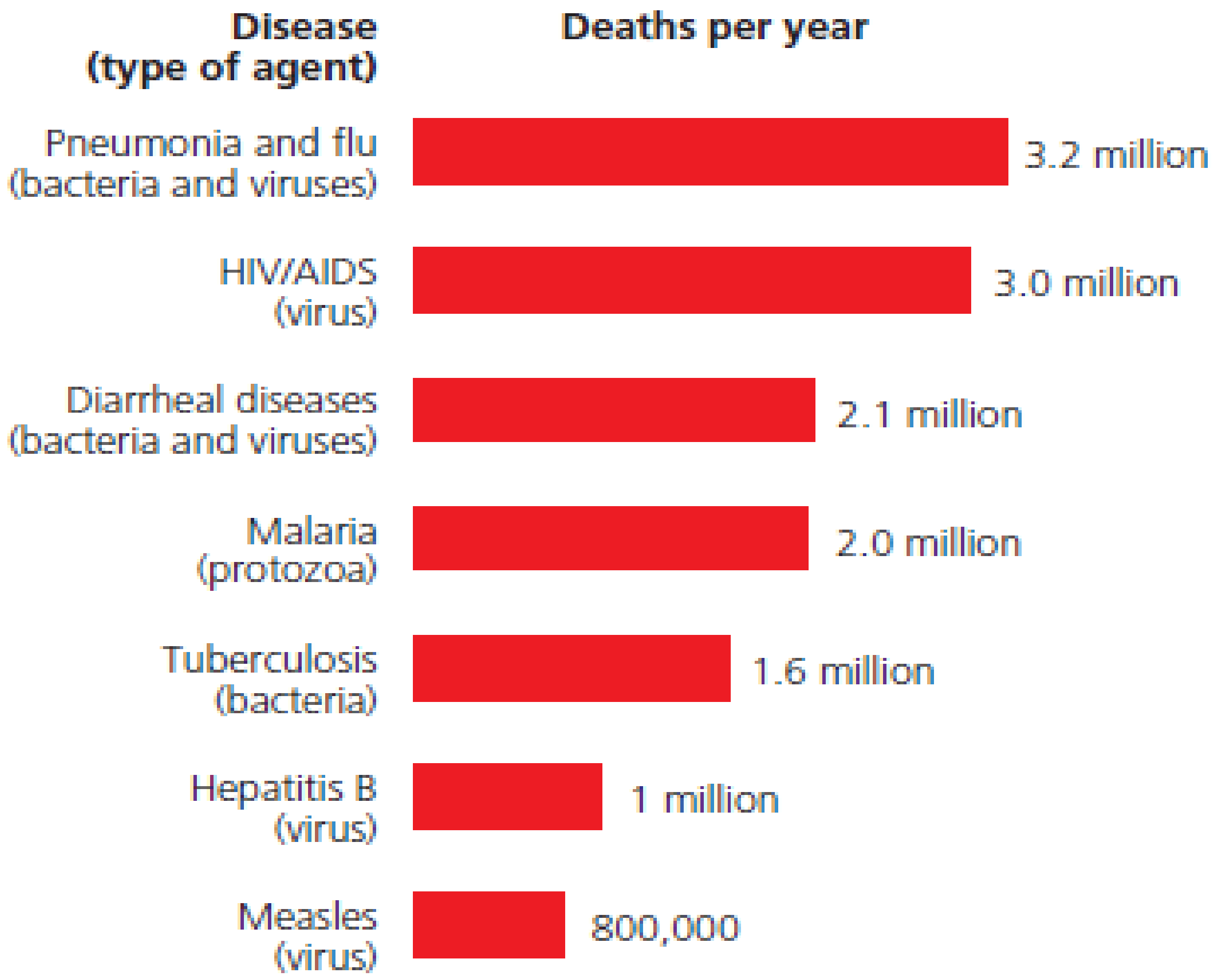


Figure 14-4 **Science:** pathways for infectious disease in humans. **Question:** Can you think of other pathways not shown here?

Disease : death rate

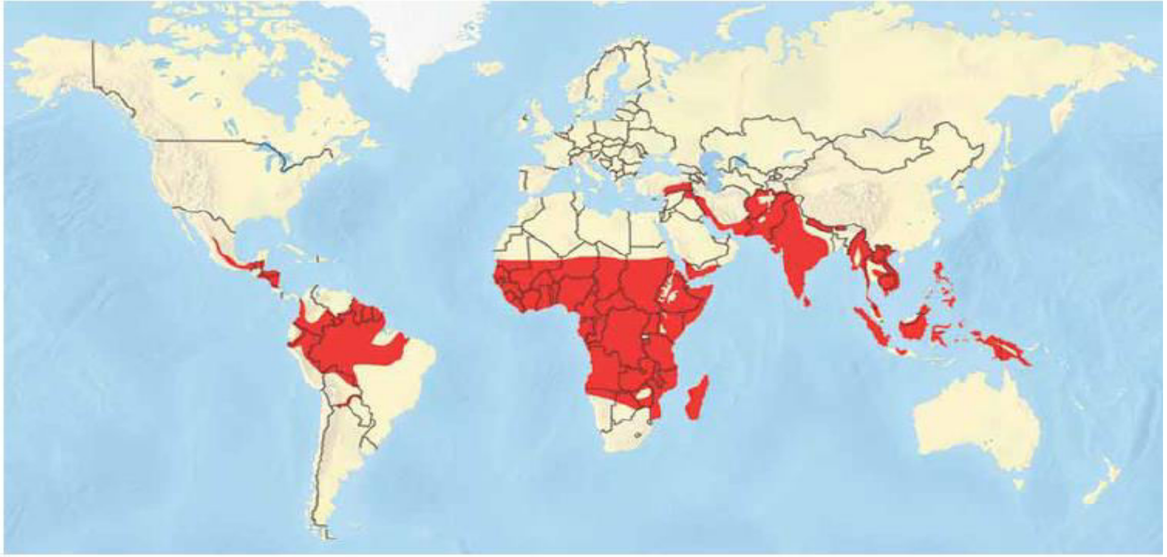


Case study 1- Global threat - TB

- Acc. WHO the highly infectious bacterial disease strikes 9 million people/yr and kills 1.6 million- 85% developing countries.
- WHO estimates 2006 to 2020 that 25 million people will die by TB.
- **Factors**: lack of TB screening and control programs.
- Most strains – TB bacterium develops genetic resistance- antibiotics.
- Population growth, urbanization, air travel, person to person contact.
- **Slow down the disease rate**: identification and treatment of people suffering with TB: chronic cough.
- Drugs should be taken every day for 6-8months.

Case study 2 Malaria – Death by Mosquito

- Acc. 2005 study, 40 % - world's people – in poor african countries are risk from malaria.
- Malaria is caused by parasite- mosquito species.
- **Symptoms:** Infect and destroys RBC, fever, chills, drenching sweats, anaemia, abdominal pain, headaches, vomiting, weakness.



Plasmodium parasite-
life cycle

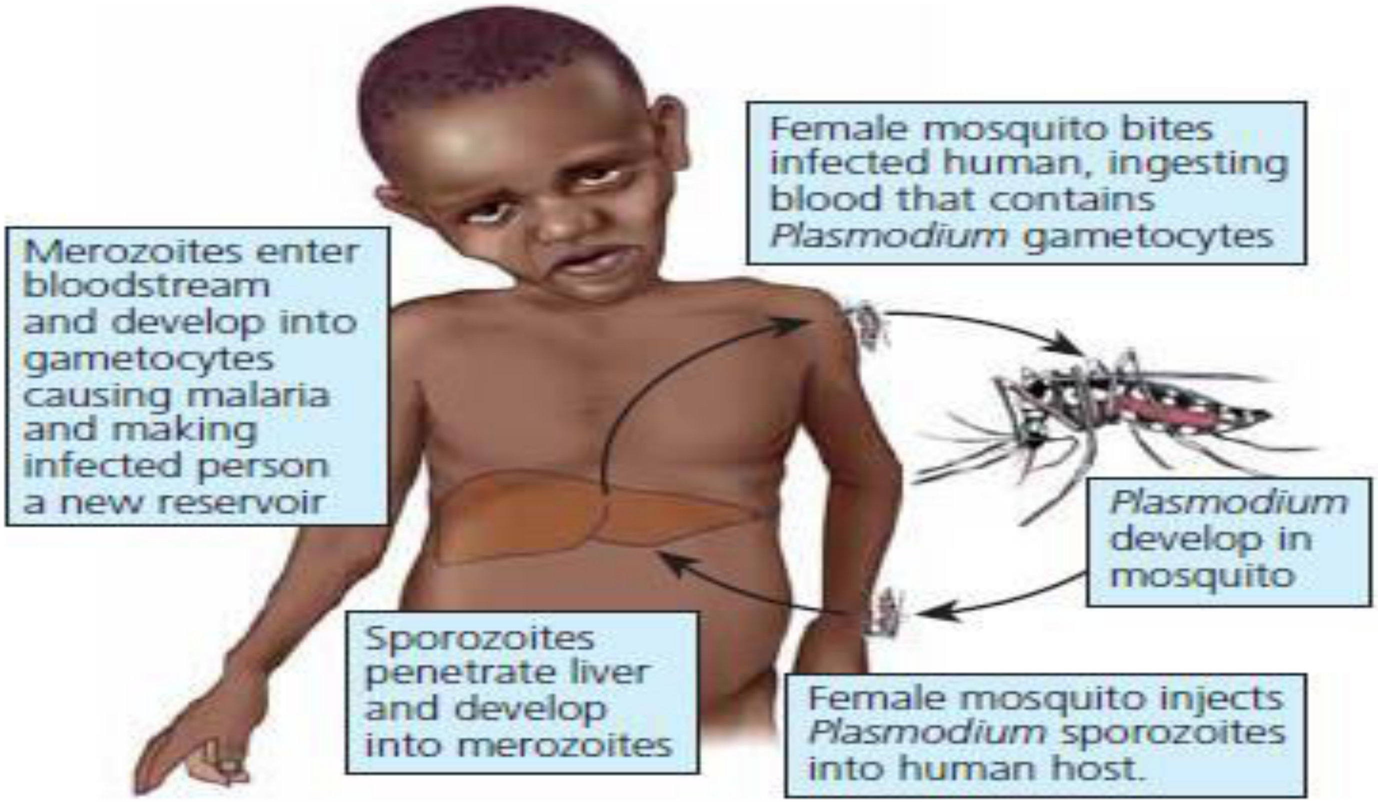


Figure 14-7 *The life cycle of malaria. Plasmodium* parasites circulate from mosquito to human and back to mosquito.

Anti-Malarial drugs

- Researcher develop new anti-malarial drugs: artemisinins, chinese medicine- sweet worm wood plant.
- Vaccines, biological controls for Anopheles mosquitoes.
- Malaria researchers were evaluating the use of fungi- harmless to the environment.

SOLUTIONS

Infectious Diseases

- Increase research on tropical diseases and vaccines
- Reduce poverty
- Decrease malnutrition
- Improve drinking water quality
- Reduce unnecessary use of antibiotics
- Educate people to take all of an antibiotic prescription
- Reduce antibiotic use to promote livestock growth
- Require careful hand washing by all medical personnel
- Immunize children against major viral diseases
- Provide oral rehydration for diarrhea victims
- Conduct global campaign to reduce HIV/AIDS

Thank You

Module -3

TYPE OF HAZARDS
Chemical Hazards

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Chemical hazards

Toxic chemical: defined as temporary or permanent harm or death to humans and animals.

Hazardous chemical: that can harm humans and other animals by being flammable or explosives or irritating or damaging the skin or lungs, interfering oxygen uptake, inducing allergic reactions.

Toxic agents

The three major potential toxic agents are

mutagens: nitrous acid-cause mutations or changes in DNA.

Teratogens: harm the fetus or embroyo. Eg: arsenic, benzene, chlorine, chloroform, chromium, DDT, lead, mercury, PCBs, thalidomide, vinyl chloride.

carcinogens: types of radiations, viruses cause cancer. eg: arsenic, vinyl chloride, chromium, PCBs, tobacco smoke

Evaluation of Chemical Hazards

Toxicology : Science that studies the harmful effects of chemicals on humans, wildlife and ecosystem, that cause toxicity and evaluate ways to prevent the hazards.

Or

A basic concept of toxicology is that any synthetic or natural chemical can be harmful if ingested in a large quantity.

Toxicity: a measure of harmful substance causing injury, illness, or death.

Toxicity also depends on *genetic makeup,* which determines an individual's sensitivity to a particular toxin. Some individuals are sensitive to a number of toxins—a condition known as ***multiple chemical sensitivity*** **(MCS)**

DAY to DAY life - Chemicals

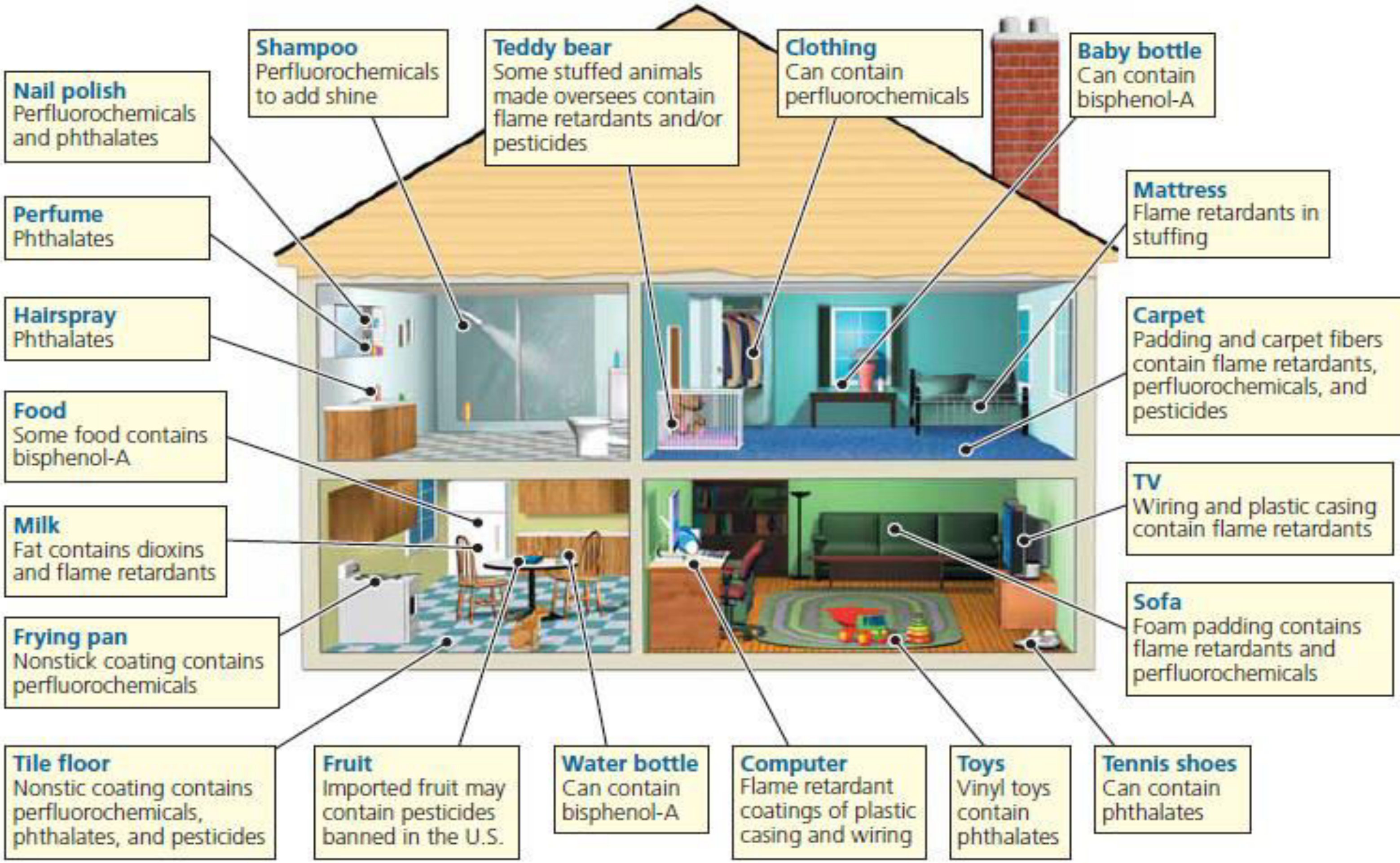

Figure 14-10 **Science:** some potentially harmful chemicals found in most homes. Most people have traces of these chemicals in their blood and body tissues. We do not know the long-term effects of exposure to low levels of such chemicals. (Data from U.S. Environmental Protection Agency, Centers for Disease Control and Prevention, and New York State Department of Health)

Five Factors – Determine Toxicity

Factor I: solubility –

- water soluble toxins can easily enter cells in our bodies.
- Fat soluble toxins can penetrate the membranes surrounding cells because the membranes allow the oil soluble chemicals to pass through them.

Factor 2: resistance to break down: Eg: DDT- long effects in humans and wildlife.

Factor 3: Bioaccumulation- even low concentration of toxic Concentration in the environment.

Factor 4: Biomagnification:

Factor 5: chemical interaction Eg. Vitamin E & A can interact to reduce harmful effects.

Age Group

For example,

Infants and young children are more susceptible to the effects of toxic substances than are adults for three major reasons.

First, children breathe more air, drink more water, and eat more food per unit of body weight than do adults.

Second, they are exposed to toxins in dust and soil when they put their fingers, toys, or other objects in their mouths, as they frequently do.

Third, children usually have less well-developed immune systems and body detoxification processes than adults have.

EPA

In 2003, the U.S. Environmental Protection Agency (EPA) proposed that in determining the risk of exposure to cancer-causing chemicals, regulators should assume that children face a risk 10 times higher than that faced by adults.

Some health scientists contend that these guidelines are too weak.

They suggest that, to be on the safe side, we should assume that this risk for children is 100 times that of adults

Difficult to Estimate

Examples of toxicants include certain pesticides, radioactive

isotopes, heavy metals such as mercury a lead, industrial chemicals such as P (polychlorinated biphenyls), and fla retardants such as PBDEs (polybromin diphenyl ethers).

Estimating the levels and effects of hun exposure to chemicals is very difficult.

because of the numerous and often poo understood factors involved in it.

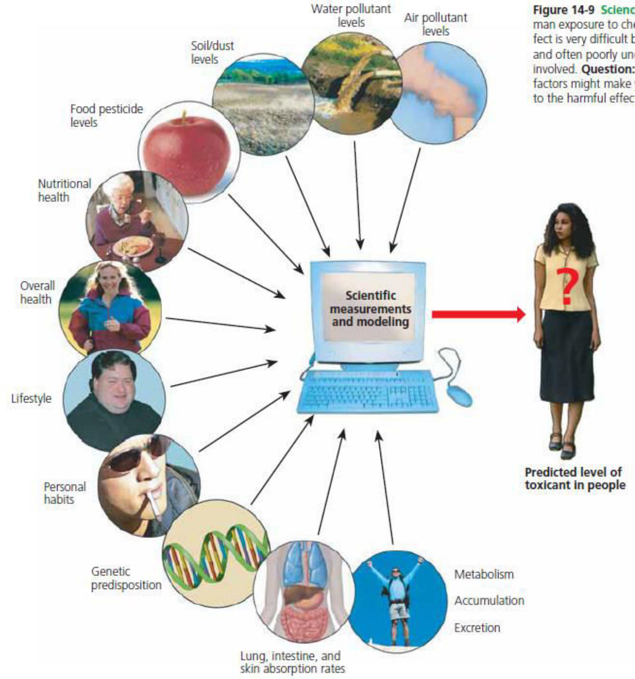

Figure 14-9 Science: estimating human exposure to chemicals and their effect is very difficult because of the many and often poorly understood variables involved. **Question:** What three of these factors might make you more vulnerable to the harmful effects of chemicals?

Stockholm Convention on persistent organic pollutants (POPs)

POPs	Usage
Alpha hexachlorocyclohexane	Pesticide, produced as byproduct of lindane
Beta hexachlorocyclohexane	Pesticide, produced as byproduct of lindane
Chlordecone	Pesticide, agricultural use
Hexabromobiphenyl ether	Flame retardant
Hexabromodiphenyl ether and heptabromodiphenyl ether	Flame retardant, recycling of articles containing these chemicals is allowed
Lindane (Gamma hexachlorocyclohexane)	Pesticide, for control of head lice and scabies as second line treatment
Pentachlorobenzene	Pesticide, unintentionally produced POPs
Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride	Industrial chemical: Photo-imaging, photo-resis and anti-reflective coatings for semi-conductor and liquid crystal display (LCD) industries, etching agent for compound semi-conductors ar ceramic filters, aviation hydraulic fluids, metal plating (hard metal plating and decorative plating), certain medical devices (such as ethyle tetrafluoroethylene copolymer (ETFE) layers an radio-opaque ETFE production, in-vitro diagno medical devices, and CCD colour filters)

FACT SHEET
Sources of the Persistent Organic Pollutants (POPs) listed under the Stockholm Convention

Persistent Organic Pollutant	Potential Main Sources
Pesticides	
Aldrin, Chlordane, DDT, Toxaphene, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene (HCB)*, Mirex ▲ Alpha-hexachlorocyclohexane (alpha-HCH)*, Beta-hexachlorocyclohexane (beta-HCH)*, Lindane, Chlordecone, Pentachlorophenol (PCP), Endosulfan	• Insecticides • Herbicides • Rodenticides • Bactericides • Fungicides • Larvicides
Industrial Chemicals	
Polychlorinated biphenyl (PCB)*,▲	• Heat exchange fluids in electrical equipment e.g. Transformers and Capacitors • Lubricants, Paints, Inks, Adhesives
Brominated Flame Retardants: Hexabromobiphenyl (HBB), Tetra-and penta-bromodiphenyl ether & Hexa-and hepta- bromodiphenyl ether (PBDE), Hexabromocyclododecane (HBCD)	• Plastics in electrical and electronic equipment • Polystyrene in transport and construction • Foams for furniture • Textile coating e.g upholstery, furniture, curtains, apparel
Fluorinated Flame Retardants: Perfluorooctane sulfonic acid (PFOS■ /Sulfluramide and PFOS-F)	• Firefighting foams • Oil drilling operations • Chrome plating industry • Aviation hydraulic fluids • Surface treatment of synthetic carpets • Textiles and leather
Unintentionally produced POPs (UPOPs)	
Polychlorinated dibenzo-p-dioxins (PCDD), Polychlorinated dibenzofurans (PCDF) Polychlorinated naphthalenes (PCNs), Hexachlorobutadiene (HCBD), Pentachlorobenzene (PeCB) ▲,■	• Waste Incineration • Metal Production • Heat and Power Generation • Production of Mineral Products • Transport

NOTES: Blue Text - Original Dirty Dozen POPs, Orange Text - Newly Listed POP
* Also produced unintentionally,
▲ Also used in fire retardants
■ Also used as a pesticide

BCRC-Caribbean - FACT SHEET on Persistent Organic Pollutants listed under the Stockholm Convention (March 2017)

List – Permitted & Prohibited

Active ingredient	Permitted since	Usage prohibited since
Hexachlorobenzene (HCB)	1962	11/07/1980
Toxaphene	1957	27/04/1982
Endrin	1957 (since 1971. Used as rodenticide)	29/05/1989
Aldrin	1958	1972
Dieldrin	1958	1972
Heptachlor	1956	July 1973
Hexachlorocyclohexane (HCH)[a]	1944	1972
DDT	1944	1972 (in agriculture)
Lindane	1944	July 2001
Chlordane	Data before 1995. Not known	1971 (in agriculture)
Mirex	Never allowed in the Croatian plant protection	

[a]Alpha-hexachlorocyclohexane, beta-hexachlorocyclohexane are on the list since 2009

International Agency for Research on Cancer

World Health Organization

IARC MONOGRAPHS ON THE IDENTIFICATION OF CARCINOGENIC HAZARDS TO HUMANS

Sr. No.	IARC Classification	POPs
1	**Group 1**: The agent (mixture) is carcinogenic to humans	• 2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)
2	**Group 2A**: The agent (mixture) is probably carcinogenic to humans	• Mixtures of polychlorinated biphenyls (PCB)
3	**Group 2B**: The agent (mixture) is possibly carcinogenic to humans	• Chlordane • DDT • Heptachlor • Hexachlorobenzene • Mirex • Toxaphene (mixtures of Polychlorinated camphenes)
4	**Group 3**: The agent (mixture or exposure circumstance) is unclassifiable as to carcinogenicity in humans	• Aldrin, Dieldrin and Endrin • Polychlorinated dibenzo-para-dioxins (other than TCDD) • Polychlorinated dibenzofuran

Source: http://www.chem.unep.ch/gpa_trial/02healt.htm

Thank You

Module -3

TYPE OF HAZARDS
Nuclear Hazards

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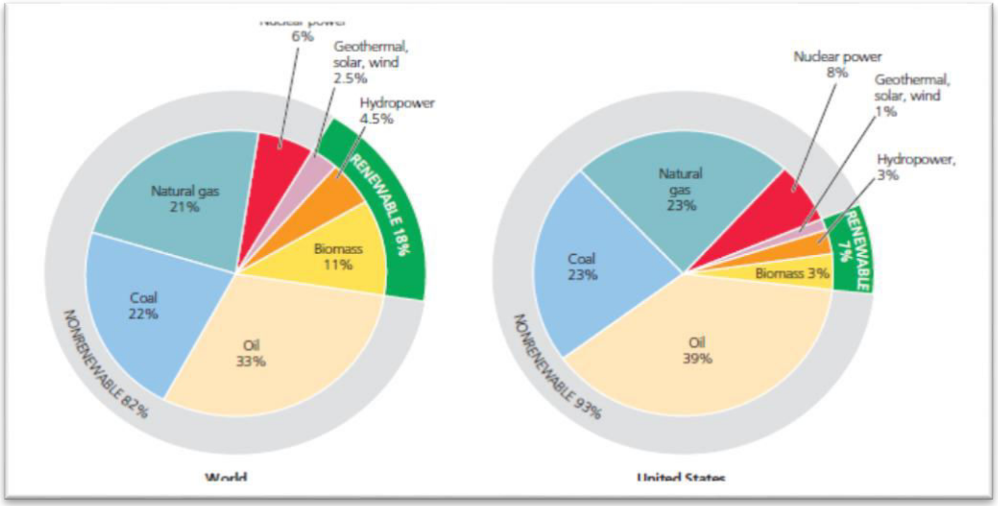
Types of Energy

Renewable Energy resources

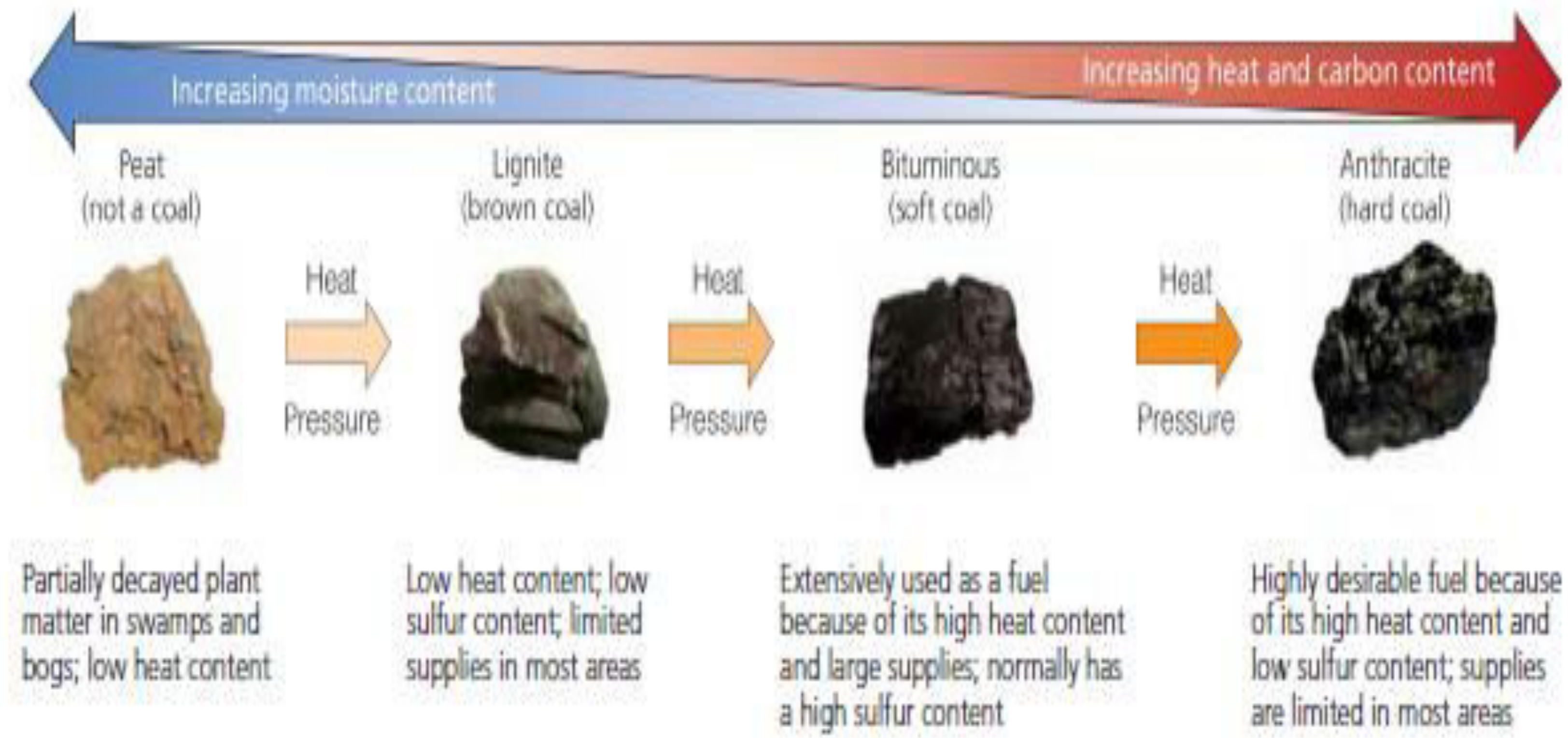
- Sun – solar energy
- Wind energy
- Hydro electrical
- Geothermal
- Ocean thermal
- Biomass energy



Non-Renewable Energy resources

- SNG, LPG, CNG, Natural gas, fossil fuels, Petrol, Diesel

Increase Carbon Value



Oil and Natural

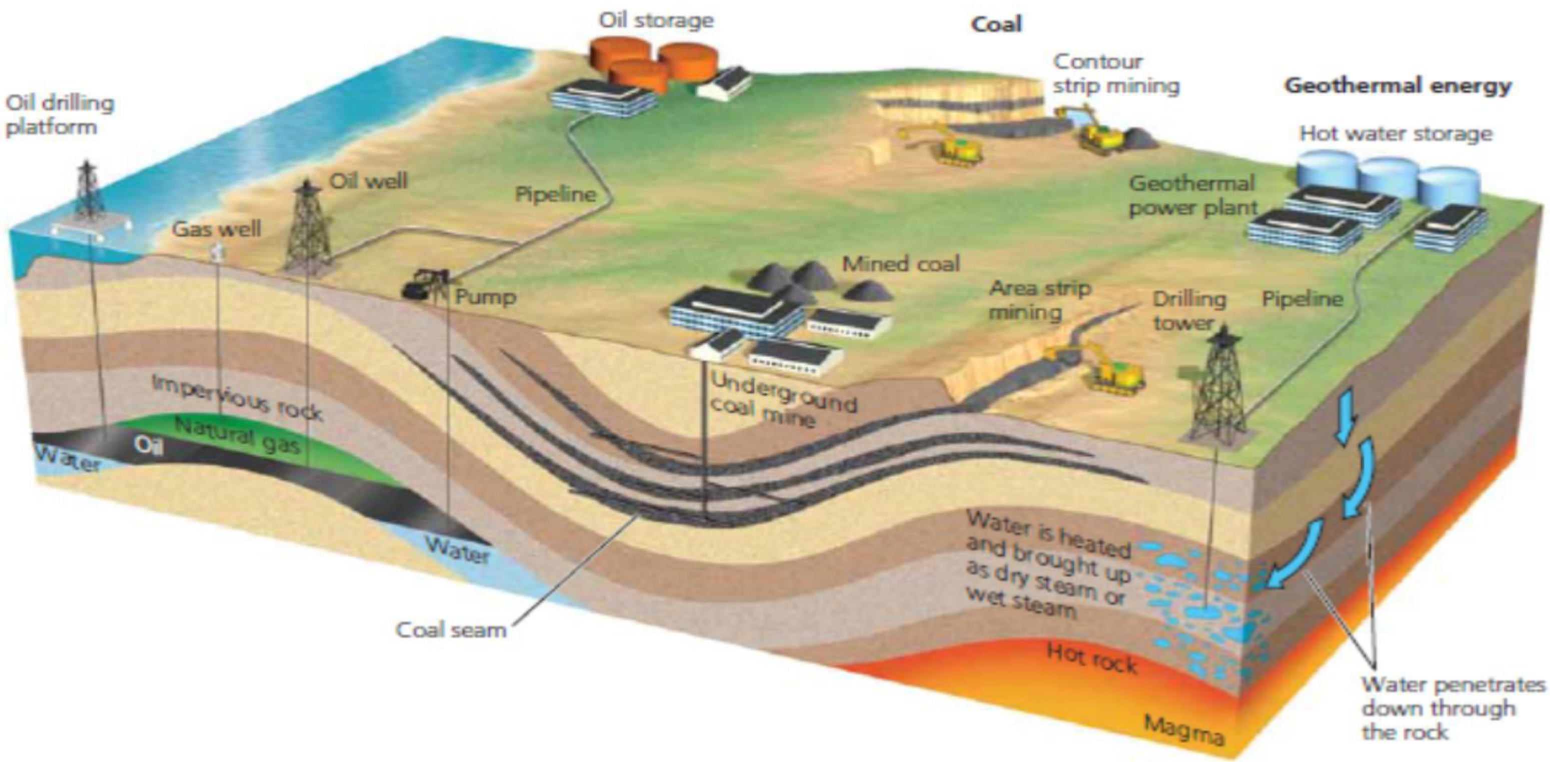


Figure 13-2 Natural capital: important nonrenewable energy resources that can be removed from the earth's crust are coal, oil, natural gas, and some forms of geothermal energy. Nonrenewable uranium ore is also extracted from the earth's crust and processed to increase its concentration of uranium-235, which can serve as a fuel in nuclear reactors to produce electricity. **Question:** Can you think of a time during a typical day when you are not directly or indirectly using one of these resources?

Advantage & Disadvantage

TRADE-OFFS

Conventional Natural Gas

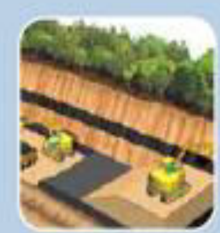
Advantages	Disadvantages
Ample supplies	Nonrenewable resource
High net energy yield	Releases CO_2 when burned
Low cost	Government subsidies
Less air pollution than other fossil fuels	Environmental costs not included in market price
Lower CO_2 emissions than other fossil fuels	Methane (a greenhouse gas) can leak from pipelines
Easily transported by pipeline	Difficult to transfer from one country to another
Low land use	Can be shipped across ocean only as highly explosive LNG
Good fuel for fuel cells and gas turbines	Sometimes burned off and wasted at wells because of low price

Gas turbine

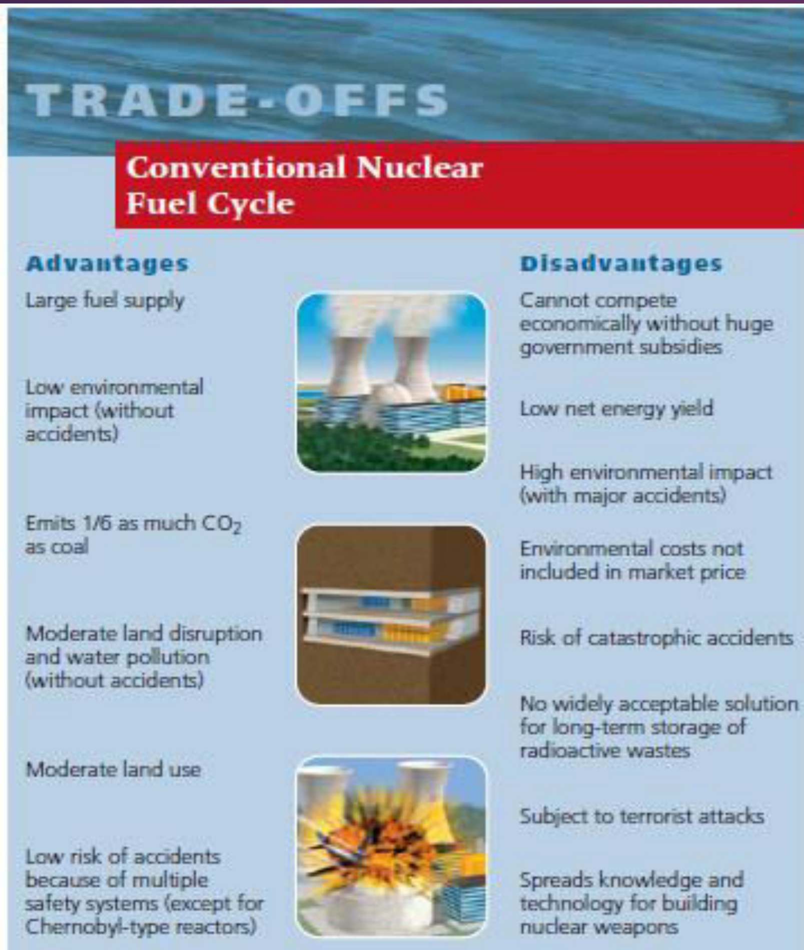
TRADE-OFFS

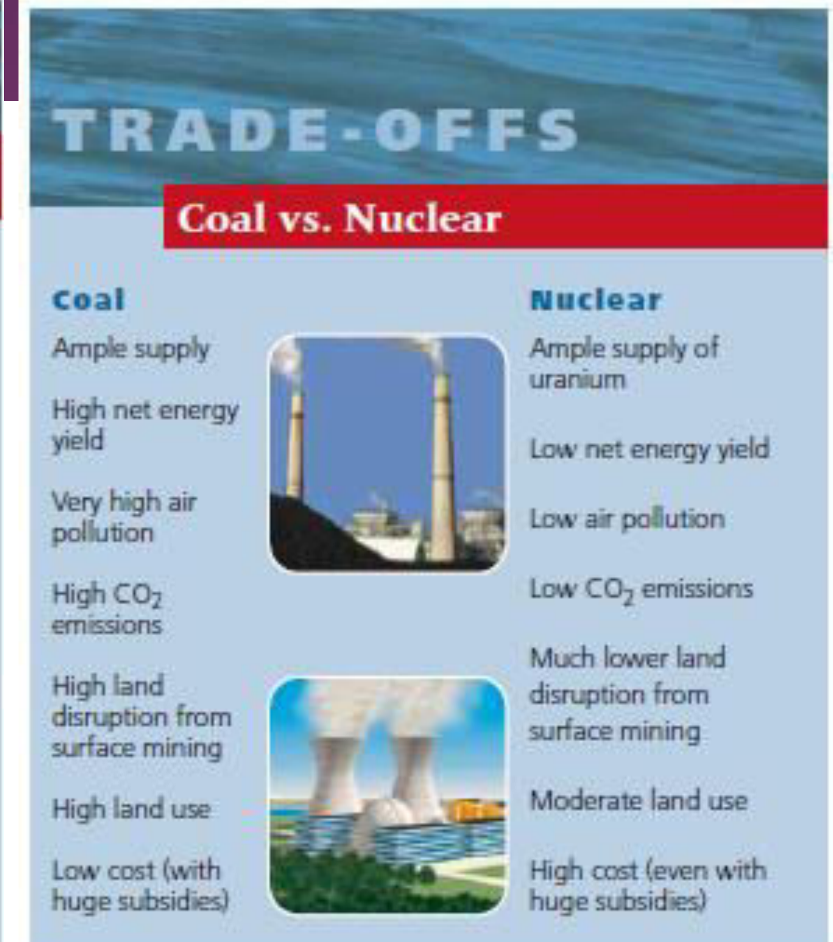
Coal

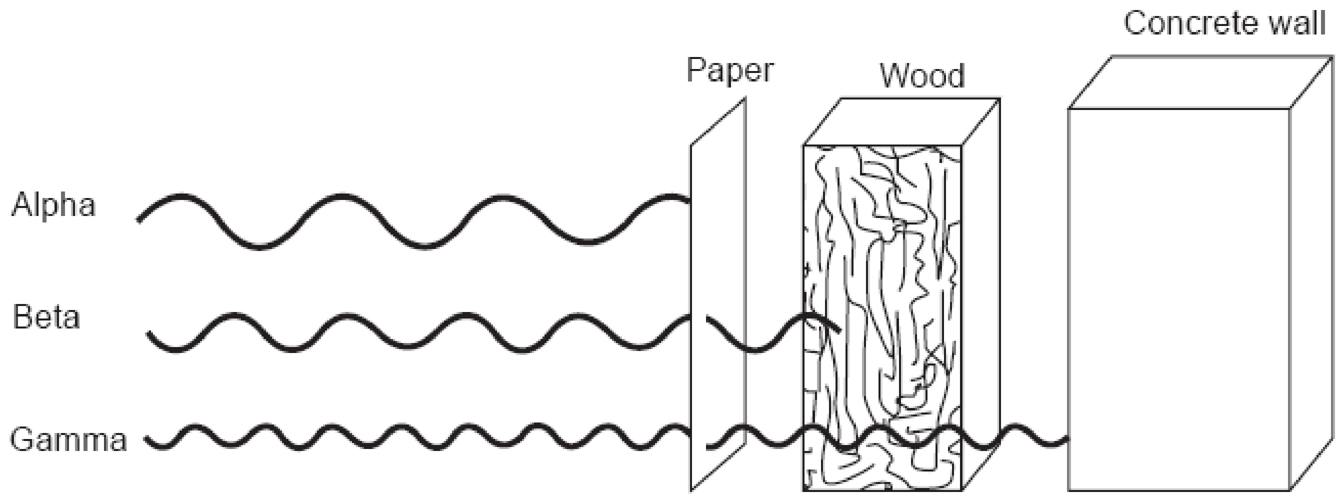
Advantages	Disadvantages
Ample supplies (225–900 years)	Severe land disturbance, air pollution, and water pollution
High net energy yield	Severe threat to human health when burned
Low cost	Environmental costs not included in market price
Well-developed technology	Large government subsidies
Air pollution can be reduced with improved technology	High CO_2 emissions when produced and burned
	Radioactive particle and toxic mercury emissions



Conventional Vs Nuclear Energy







1. Radioactive substances are present in nature.

2. They spontaneously gives out fast moving particles, high energy radiations or both, until it form a stable isotope.

Gamma rays – high energy electromagnetic radiation or ionization particles

Alpha – fast moving positively charged particles

Beta – High speed negatively charged electron.

Penetration power: $\alpha < \beta < \gamma$

Sources and Effects of Radiations

Sources:

(i) **Natural sources:** **Radon-222, Soil, rocks, air, water and food.**

(ii) **Anthropogenic Sources:** **Nuclear power plant, Nuclear accidents, X-rays, Diagnostic kits, test laboratories.**

Effects of radiations:

i) Genetic damage – DNA and chromosomes

ii) somatic damage – Burns, miscarriages, eye cataract, cancer of bone, thyroid, breast, lungs and skin.

Iodine(I^{131}) – Thyroid gland – Cancer

Strontium-90- leukemia or cancer of bone marrow.

Nuclear Hazards

JAPAN Case Study- 1

- The atomic bomb named "Little Boy" was dropped on Hiroshima by the Enola Gay, a Boeing B-29 bomber, at 8:15 in the morning of August 6, 1945.
- "Fat Man" was dropped on Nagasaki 3 days later on August, 9, 1945.

The bombs killed as many as 1,40,000 people in Hiroshima and 80,000 in Nagasaki by the end of 1945.

Most of the dead were civilians.

Acute Effects

- The most common acute disorders were **epilation**, symptoms of damage to mucous membranes including **diarrhea, dysentery, melena and bleeding from gums, and impeded blood-forming functions.**
- The **acute effects had largely subsided by the end of December**, approximately five months after the bombing.

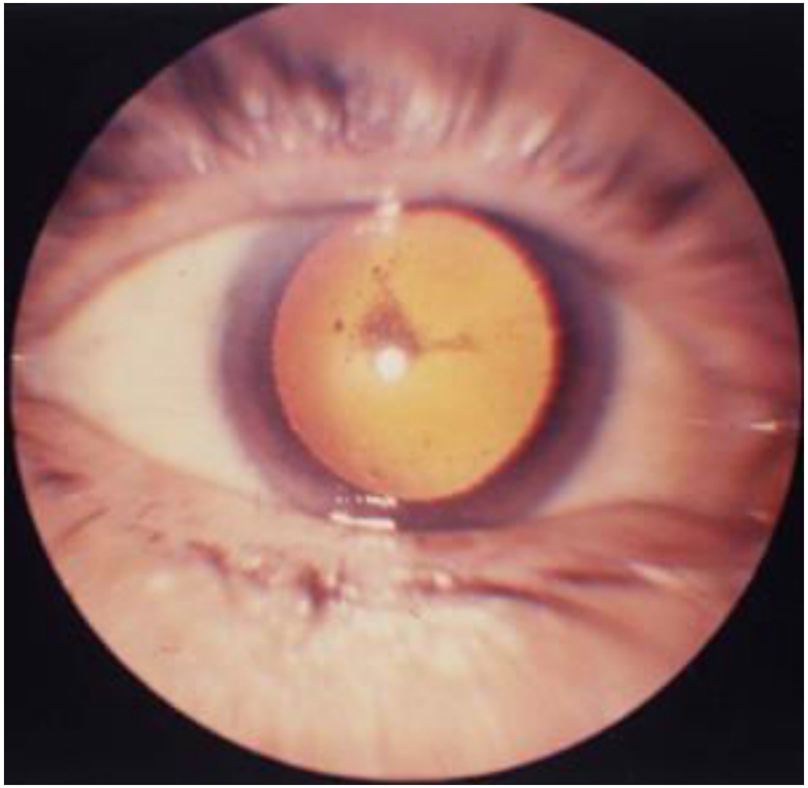
Hair combed off of head in 3 strokes of a brush

Radiation

- The defining characteristic of an atomic bomb that distinguishes it from any conventional bomb is radiation.
- Those exposed within about 1000 meters of the hypocenter received life-threatening doses, and most died within a few days.
- Decades later, that radiation was still producing harmful aftereffects.
- Leukemia and other cancers appeared over the course of 2 to 20 years, and radiation effects still threaten the health of the survivors.

Cataracts

Cataracts occurred several months to several years after exposure.

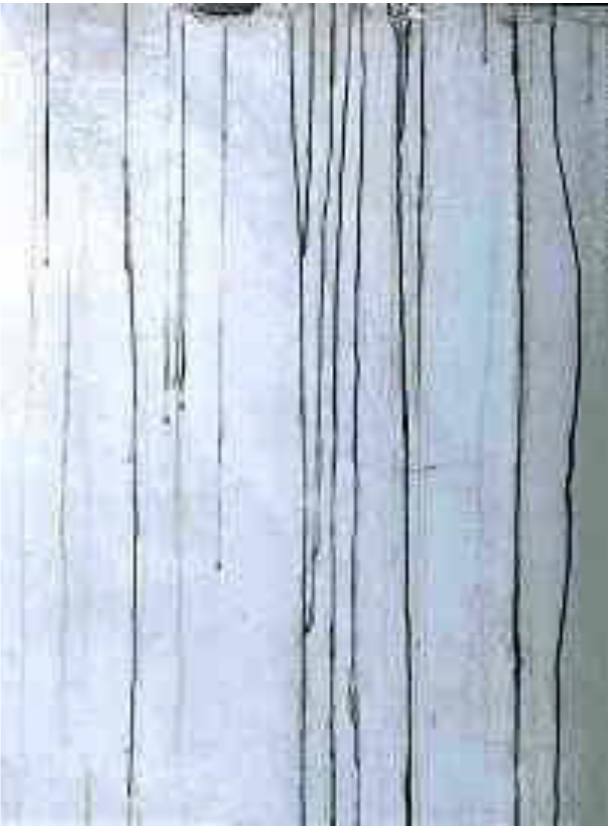


Keloids

Scars left by exposure to heat and radiation erupted 2-3 years after the blast

Black Rain

Soon after the explosion, a giant mushroom cloud billowed upward, carrying dirt, dust, and other debris high into the air. After the explosion, soot generated by the conflagration was carried by hot air high into the sky. this dust and soot became radioactive, mixed with water vapor in the air, then fell back to earth in what came to be called "**black rain.**“



The black rain contained radioactive material. Fish died and floated to the surface in the ponds and rivers where this rain fell. Many of the people who drank from wells in areas where the black rain fell suffered from diarrhea for three months.

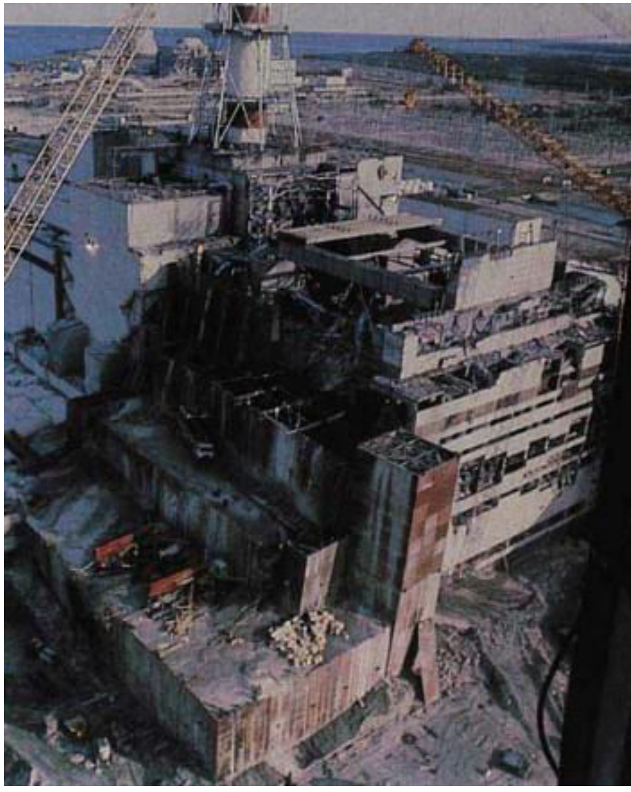
Pictures

Hiroshima Today

Chernobyl Nuclear Disaster

On the 26th April 1986 a plant reactor exploded during a failed cooling system test, igniting a massive fire that burned for ten days. At 1:23am the reactor became out of control creating explosions and a fireball which blew off the reactor's heavy steel and concrete lid.

The accident released radioactivity equivalent to 400 times that of the Hiroshima bomb.
More than 350,000 people were displaced and scientists estimate up to 90,000 square miles of land in Belarus, Ukraine, and Russia (all part of the Soviet Union at the time) were contaminated with unhealthy levels of radioactive elements.



So what?

- Radioactivity damages our DNA and changes our body's cells. This causes cancer and mutations.
- Serious exposure to radiation is likely to cause death within 2 to 4 weeks.
- 176 people were working at the reactor that night. Most were killed instantly, others died agonising deaths soon afterwards.
- Many of those who didn't die from the exposure have gone on to give birth to a mutated generation.

Thank You

WATER FOOTPRINT

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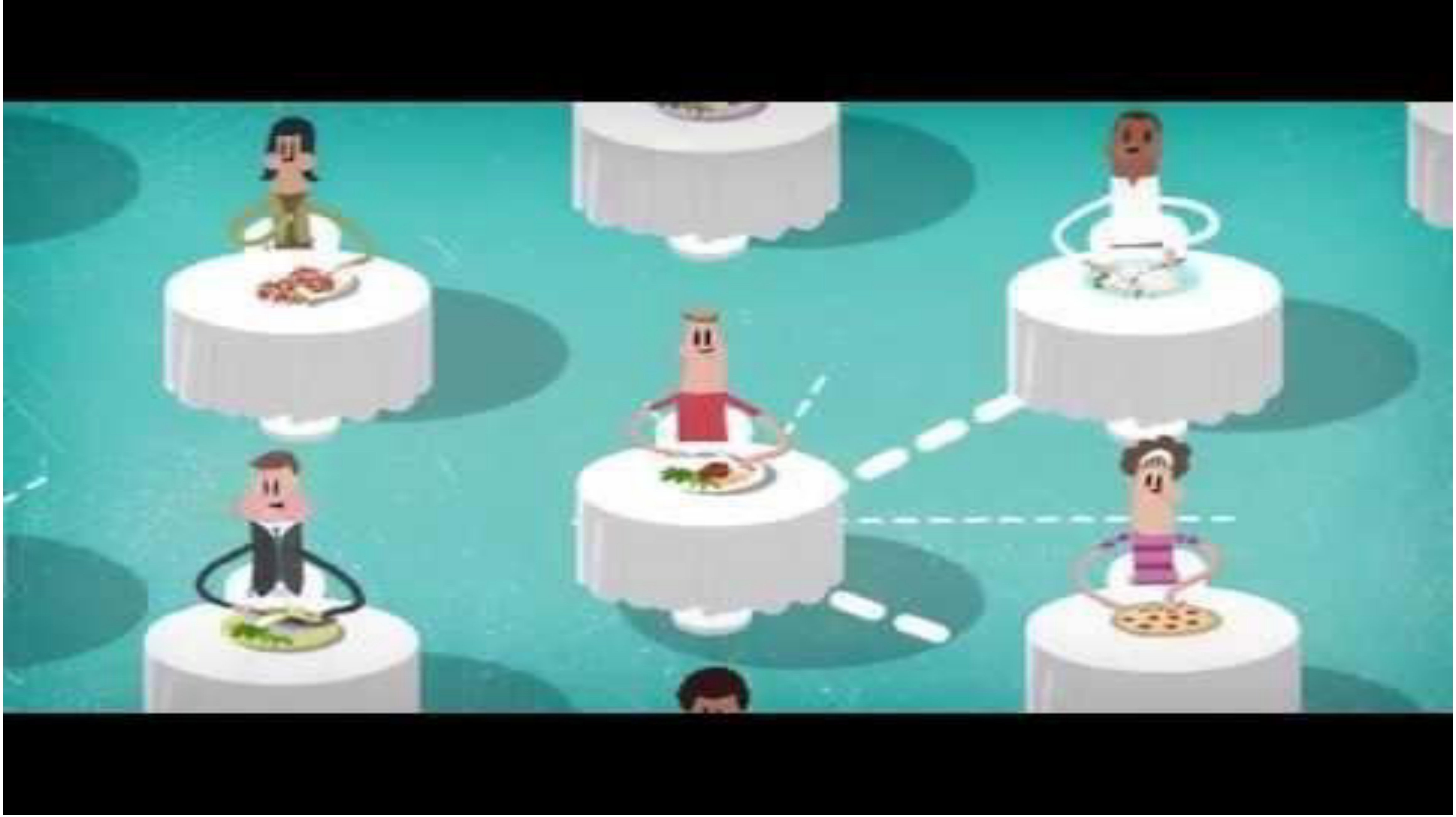


What is a water footprint?

Everything we use, wear, buy, sell and eat takes water to make.

The water footprint measures the amount of water used to produce each of the goods and services we use.

It can be measured for a single process, such as growing rice, for a product, such as a pair of jeans, for the fuel we put in our car, or for an entire multi-national company.

The water footprint can also tell us how much water is being consumed by a particular country – or globally – in a specific river basin or from an aquifer.

The water footprint is a measure of humanity's appropriation of fresh water in volumes of water consumed and/or polluted.

Some facts and figures

The production of one kilogramme of beef requires approximately 15 thousand litres of water (93% green, 4% blue, 3% grey water footprint). There is a huge variation around this global average. The precise footprint of a piece of beef depends on factors such as the type of production system and the composition and origin of the feed of the cow.

The water footprint of a 150-gramme soy burger produced in the Netherlands is about 160 litres. A beef burger from the same country costs on average about 1000 litres.

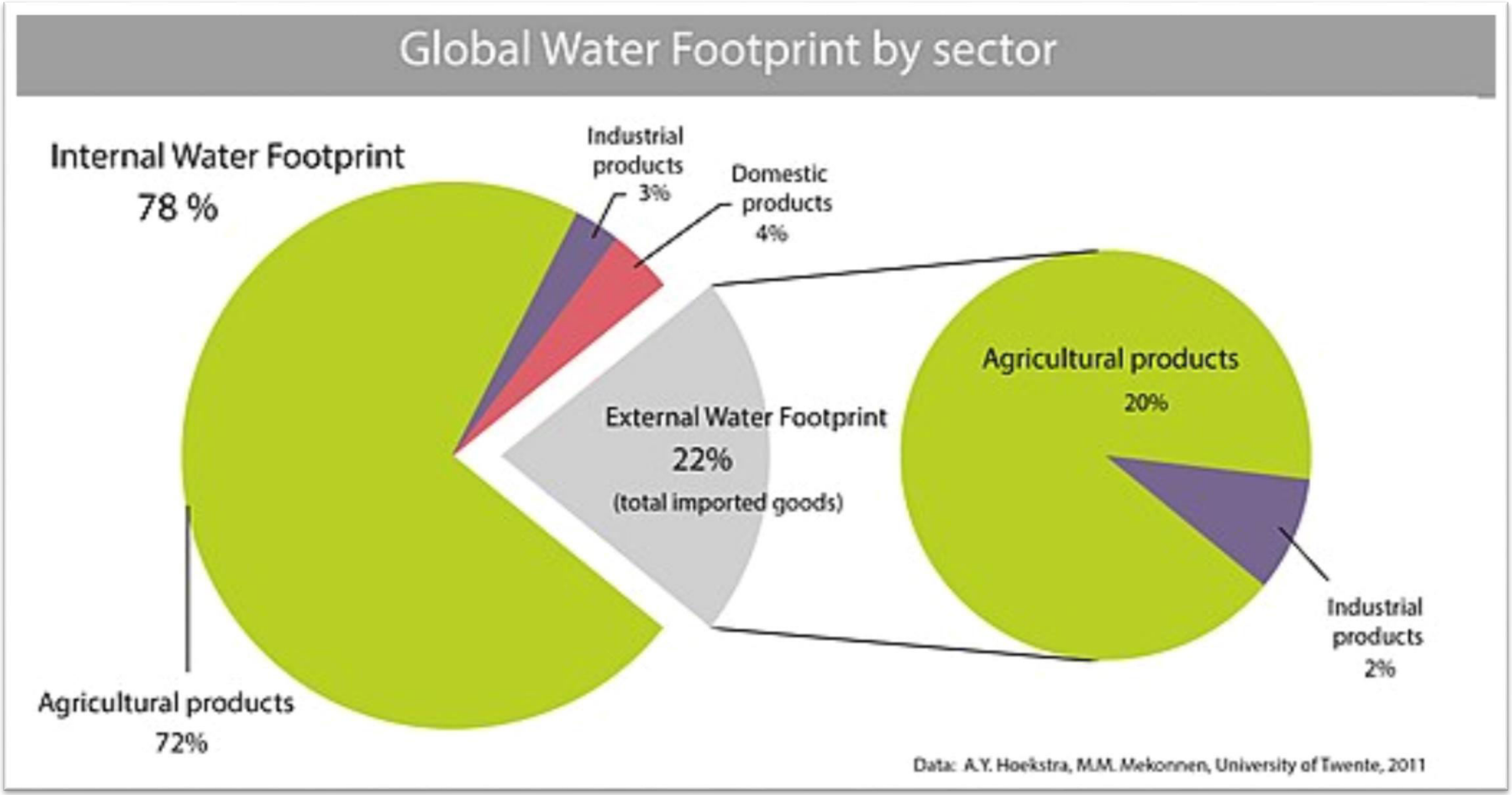
The water footprint of Chinese consumption is about 1070 cubic metres per year per capita. About 10% of the Chinese water footprint falls outside China.

Japan with a footprint of 1380 cubic metres per year per capita, has about 77% of its total water footprint outside the borders of the country.

The water footprint of US citizens is 2840 cubic meter per year per capita. About 20% of this water footprint is external. The largest external water footprint of US consumption lies in the Yangtze River Basin, China.

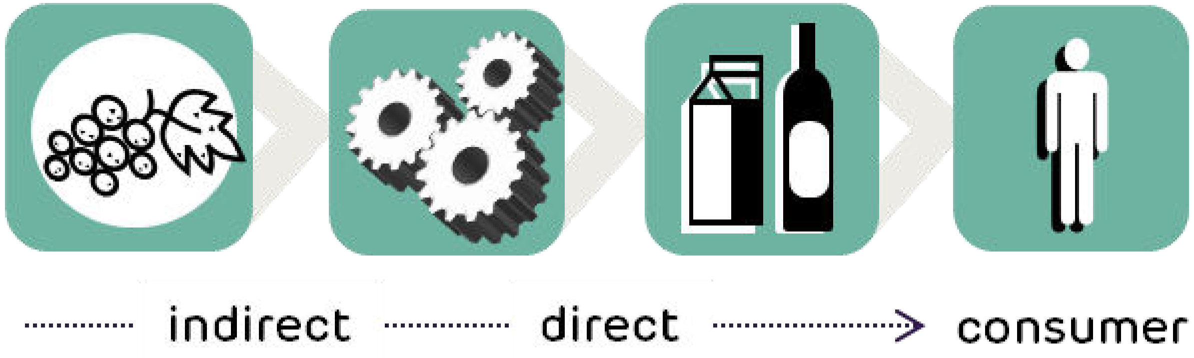
The global water footprint of humanity in the period 1996-2005 was 9087 billions of cubic meters per year (74% green, 11% blue, 15% grey). Agricultural production contributes 92% to this total footprint.

Water scarcity affects over 2.7 billion people for at least one month each year.


Global Water Footprint by sector
Internal Water Footprint
78 %
Industrial products 3%
Domestic products 4%
External Water Footprint
22%
(total imported goods)
Agricultural products
20%
Industrial products
2%
Agricultural products
72%
Data: A.Y. Hoekstra, M.M. Mekonnen, University of Twente, 2011

Direct and indirect water use

The water footprint looks at both direct and indirect water use of a process, product, company or sector and includes water consumption and pollution throughout the full production cycle from the supply chain to the end-user.



The three water footprints:

Green water footprint

Blue water footprint

Grey water footprint

Water Footprint

Green water footprint is water from precipitation that is stored in the root zone of the soil and evaporated, transpired or incorporated by plants. It is particularly relevant for agricultural, horticultural and forestry products.

Blue water footprint is water that has been sourced from surface or groundwater resources and is either evaporated, incorporated into a product or taken from one body of water and returned to another, or returned at a different time. Irrigated agriculture, industry and domestic water use can each have a blue water footprint.

Grey water footprint is the amount of fresh water required to assimilate pollutants to meet specific water quality standards. The grey water footprint considers point-source pollution discharged to a freshwater resource directly through a pipe or indirectly through runoff or leaching from the soil, impervious surfaces, or other diffuse sources.

Solutions

Individual Responsibility

Intergrated Rainwater Harvesting can involve Harvesting and storing rainwater for future use in pits, pools and ponds.

Updated rainwater harvesting systems collect water for future irrigation and store it in aquifers to protect it from evaporation loss – a system called water banking.

Dry Farming, or growing during the dry season where the crops rely on residual soil moisture, is regularly practiced for crops like wine grapes and olives, as well as other Crop like tomatoes

Some of the best ways to lower water footprints and facilitate water uptake is by taking care of the soil by using low or no-till practices, using crop rotations and planting cover crops to replenish soil naturally.

Agroecology is a promising approach that can help build healthy soils on farmland to store more carbon and water while requiring less polluting fertilizer and pesticides.

Thank You

WATER CONSERVATION

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Water footprints and Virtual water

A rough measure of the volume of fresh water that we use directly and indirectly to keep us alive and to support our lifestyles

Accordingly to Eco-Business report, While India's water footprint — 980 cubic meters per capita – ranks below the global average of 1,243 cubic meters, its 1.2 billion people collectively contribute to a significant 12 per cent of the world's total water footprint.

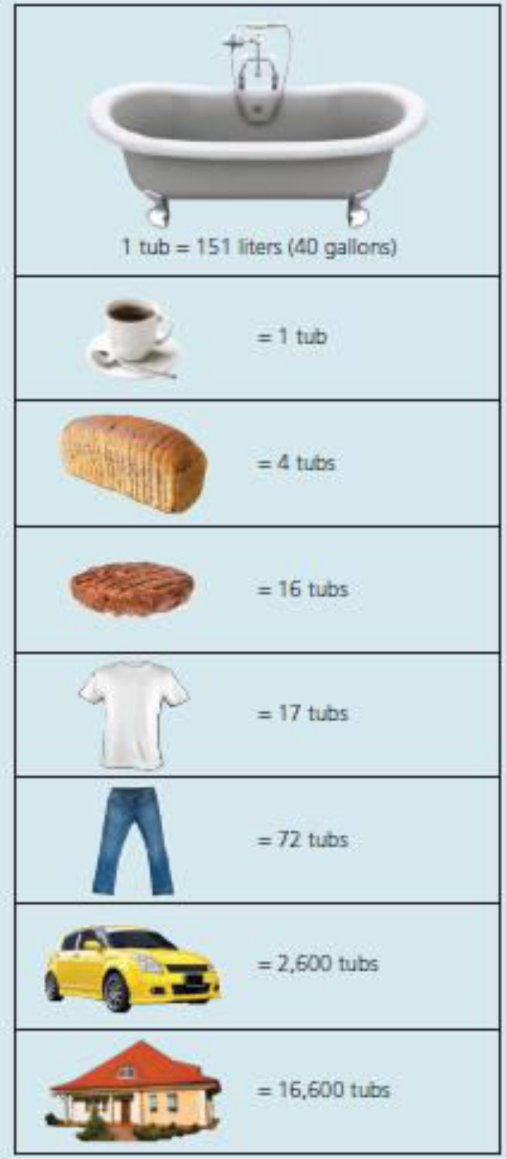
This number, say experts, is simply not sustainable and urgent measures need to be adopted by the government, corporates and citizens to optimally manage this fast dwindling precious resource.

India has four per cent of the world's water which has to cater for 16 per cent of the world's population, says a 2013 report *Sustaining India's Water Resources* by the Carbon Disclosure Project. This requirement will, it states, lead to a steady shrinking of per-capita availability.

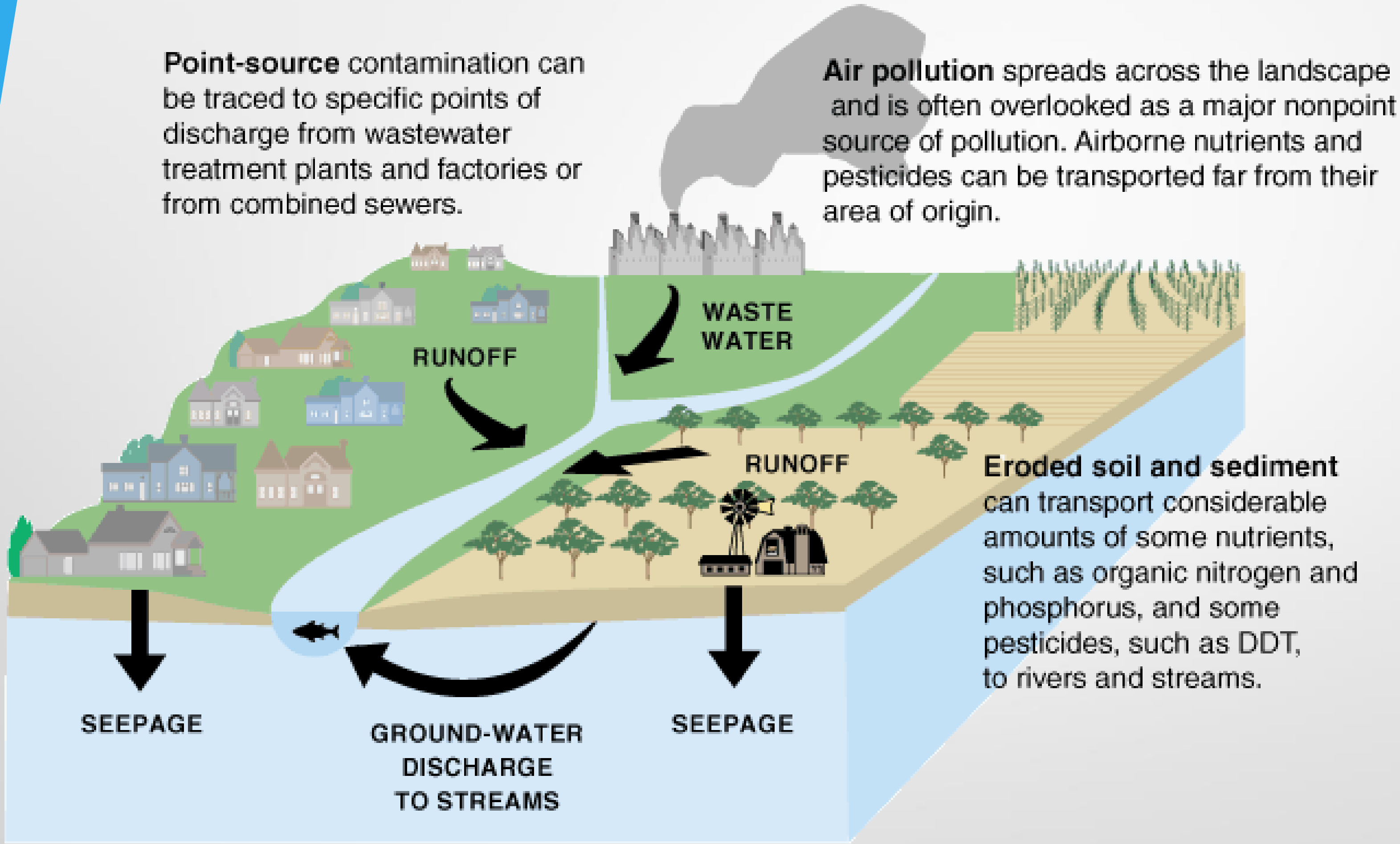
VIRTUAL WATER

Water that is not directly consumed but is used to produce food and other products is called **virtual water**, and it makes up a large part of our water footprints, especially in more-developed countries. Figure 13-A shows examples of the amounts of virtual water used for producing and delivering products. These values can vary, depending on how much of the supply chain is included, but they give us a rough estimate of the size of our water footprints.

Because of global trade, the virtual water used to produce and transport the wheat in a loaf of bread or the coffee beans used to make a cup of coffee (Figure 13-A) is often withdrawn as groundwater or surface water in another part of the world. For some countries, it makes sense to save real water by importing virtual water through food imports, instead of producing all of their food domestically. Such countries include Egypt and other Middle Eastern nations in dry climates with little water. Five countries—the Netherlands, Jordan, the United Kingdom, Japan, and South Korea—depend on virtual water imports for more than 62% of their water needs.



Water quality : Point-source and Non-point source




Catchment Water Quality Management
WATER CYCLE
Condensation
Evaporation
Transpiration
Rainfall
Run-off
Infiltration
11 Water uses
5 Water users
Potential impacts
Disposal of heated water
Power station
Mining operations
Discharge of water found underground
Streamflow reduction activity
Irrigation with waste
Treated water
Waste water treatment works
Storage
Industry
Abstraction
Aquatic ecosystem
Impeding the flow
Industrial discharge
Recreation
Recreation
Altering the banks of a watercourse
Agriculture
Borehole
Domestic
Industrial pollution and solid waste disposal
Nitrates and other agrochemical pollution
Drinking water
Water Quality Management
For more information contact Tel: (012) 336 7542 www.dwaf.gov.za/dir_wqm

Water conservation

- Decreasing run-off losses.
  - Contour cultivation
  - Conservation bench terracing
  - Water spreading
  - Chemical wetting agents (surfactant)
  - Surface crop residues
  - Chemical conditioners like gypsum, HPAN-Hydrolysed Polyacrylonitile
  - Water storage structures

- Reducing evaporation losses
    - Eg. A co-polymer of starch and acrylonitrile called "**super slurper**" – absorbs water upto 1400 times its weight.
- Storing water in soil
- Reducing irrigation losses
- Re-use of water
- Preventing the wastage of water
- Increasing block pricing

Rain Water Harvesting

- Rain water harvesting is a technique of increasing the recharge of groundwater by capturing and storing rain water.
- This is done by dug-wells, percolation pits, lagoons, check dams etc..
- The annual average rainfall in India is 1200mm. (Jun-Sep)
- **Cherapunji** second highest rainfall as 11000mm.

Objective of rain water harvesting

- To reduce run off loss
- To avoid flooding of roads
- To meet the increasing demands of water.
- To raise the water table by recharging the ground water.
- To reduce ground water contamination.
- To supplement ground water supplies during lean season.

Harvesting methods

- To store in big tanks, reservoirs above or below the ground.
- Constructing pits, dug-wells, lagoons, trench etc
- By recharging the ground water.

Traditional rain water harvesting

- In Himalayas, The foot hill people use hollow bamboos as pipelines to transport the water of natural springs.
- In Rajasthan, ‘Tankas’- underground tanks.
- Khadins – embankment
- In ancient times, talaabs, Baawaris, Johars, Hauz etc……

Modern Techniques of Rain Water Harvesting

Magsaysay award

- checks dams made of any native material, like rocks, plants, loose rocks…..
- They constructed for harvesting runoff from large catchment's area.
- Rajendra Singh of Rajasthan popularly known as “Water man”

Roof Top Water Harvesting

- Low cost
- Effective technique for urban and rural areas.
- Recharge the aquifer.
- Improves groundwater quality by dilution
- Improves soil moisture.
- Reduces soil erosion by minimizing the runoff water.

Watershed Management

- The land area drained by a river is known as the **river basin**.
- Thus watershed is defined as the land area from which water drains under gravity to a common drainage channel.
- Ranges from **few KM to 1000 Kms** in size.
- The management of watersheds treating them as basic fundamental unit.
- Was adopted in 1949 by **Damodar Valley Corporation.**

Watershed degradation

Objective of Watershed Management

- To rehabilitate the watershed through proper land use.
- To manage the watershed for beneficial development activities.
- To Minimize the risks of floods, droughts, and landslides.
- To develop rural areas in the region with clear plans.

Watershed Management Practices

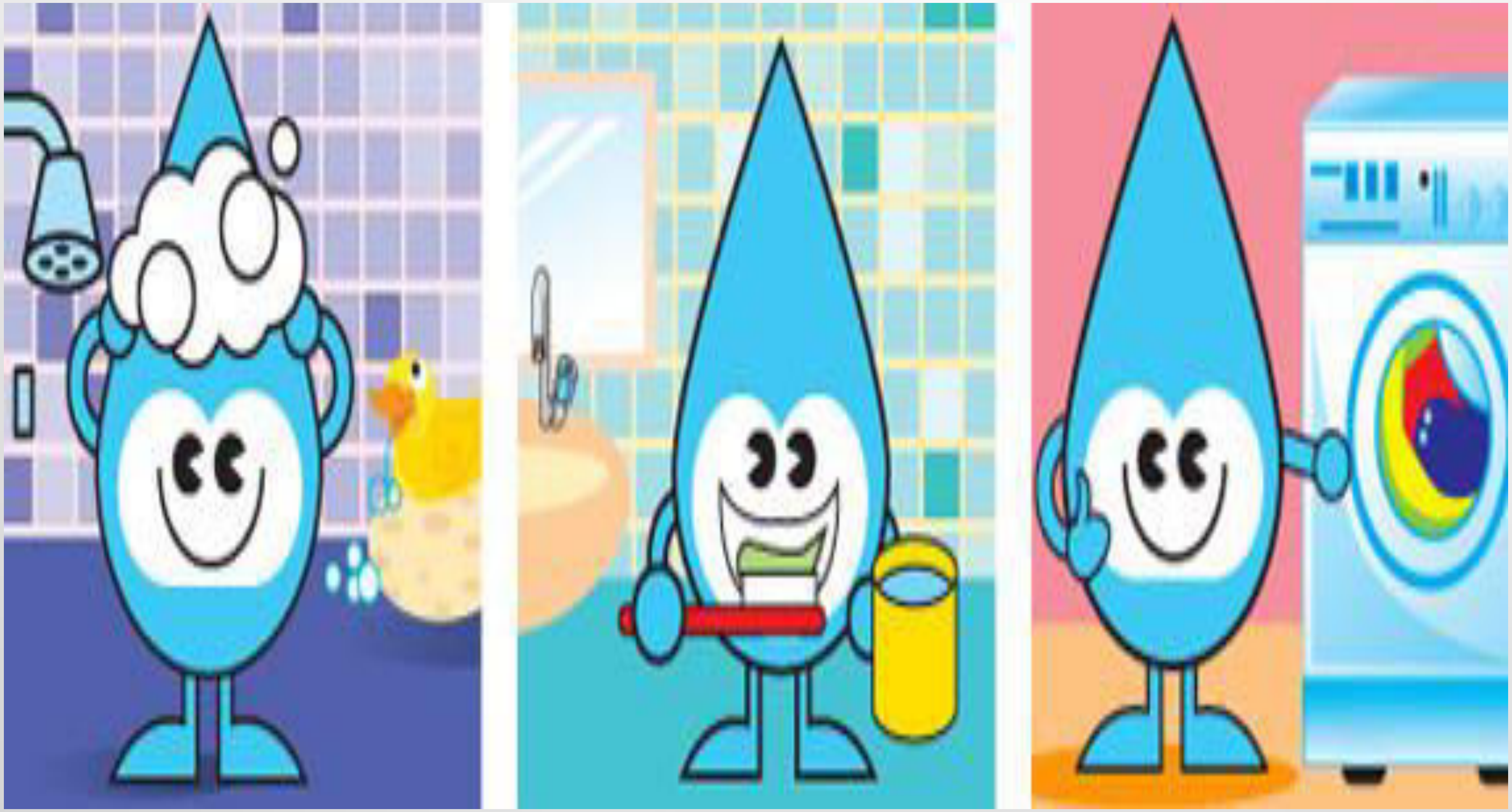
- Water harvesting
- Afforestation and agroforestry
- Mechanical Measures for reducing soil erosion and runoff
- Scientific mining and quarrying
- Public participation.

Resettlement and Rehabilitation Issues

- Displacement problems due to dams.
  - Hirakund dam has displaced more than 20,000 peoples residing in about 250 villages.
  - Bhakra Nangal Dam was constructed during 1950's – Rehabilitate was not done till now.
  - Tehri Dam on river Bhagirathi.(3 decade) long compaign - Sunderlal Bahuguna the propagator of chipko movement.
  - 10,000 residents of tehri town.
  - Displacement due to mining.

Tehri Dam

Conserve Water



Thank You

SOILD WASTE MANAGEMENT

By

Dr. V. Sai Saraswathi., M. Pharma., Ph. D.,

Environmental Science Professor,

School of Advanced Sciences

VIT University, Vellore- 632014

Contents

- Sources of urban and Industrial wastes
- Effects of solid wastes
- Management of solid wastes

Sources of Urban & Industrial wastes

- Management of solid waste is very important in order to minimize the adverse effects of solid wastes.

Urban Waste

- Medical waste from hospitals
- Municipal waste: Homes, Offices, Markets
- Horticulture waste: Parks, gardens etc.
- Small cottage units

Waste from hospitals

Wastes from homes

- Domestic waste: Polyethylene bags, empty bottles, aluminum cans, scrap metals, waste paper, cloth, food waste, diapers etc…

Waste from shops

- Waste papers, packaging material, bottles, PE bags, tea leaves, eggshells etc…






Biomedical waste

- Anatomical waste, pathological waste, Infectious waste etc…..

Construction wastes

- Debris, Wood, concrete etc….

Horticulture Waste & Slaughter Animal House

- Vegetables parts, residues, Slaughtered animals …..

Types of waste

- Biodegradable waste

  eg. Stale food, tea leaves, vegetable wastes

- Non- Biodegradable waste

  eg. PE bags, scrap metals, bottles etc

Effect of solid waste

- Municipal solid waste heap up the roads.

- Dumping of materials
- Industrial wastes
- Toxic substances
- Mixing of hazardous substances with garbages.
- Burning of materials
- Polychlorinated biphenyls,
- Leads cancer and death.

Management of Solid Waste

- Stress about the 3 “R”s

Reduction of Use of Raw Materials

- Decrease the production of waste.

Reuse of waste materials

Recycling of materials

Discarding of waste

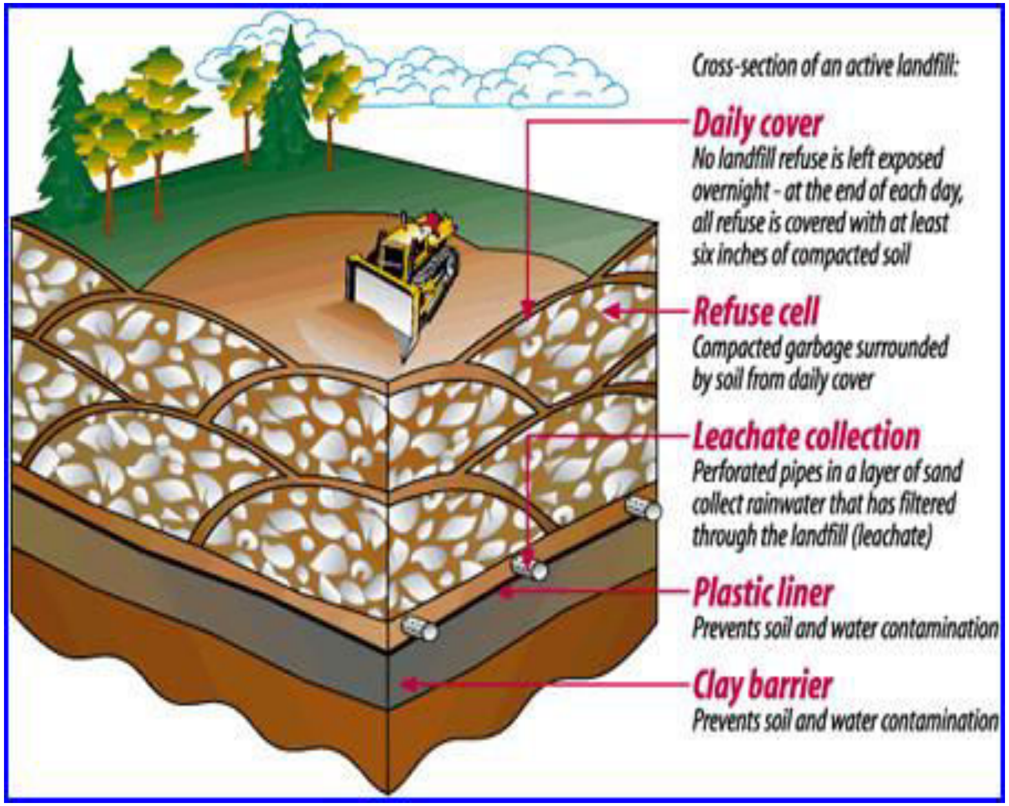
- Sanitary landfill
- Composting
- Incineration

Method to discard the waste materials:

1) Sanitary landfill 2) Composting 3) Incineration

1. Sanitary landfill

Sanitary landfills are sites where waste is isolated from the environment until it is safe.



Advantages:

1. Simple and economic
2. Segregation not required
3. Land can be reclaimed and used for other purpose.

Disadvantages;

1. Large area is required
2. Bad odors, if properly not managed
3. Causes fire hazard due to the formation of methane in wet weather.

2. Composting:

Biodegradable yard waste is allowed to degrade in the oxygen rich medium.

Environmentally friendly manure is formed.

Which improves the soil fertility

Incineration:

Burning of large amount of waste at high temperature.

Initial cost is high.

During incineration large amount of dioxin, furans, cadmium and lead will be emitted.

So remove batteries and plastics before burning the materials.

Thank You

Global Climate Change

By
Dr. V. Sai Saraswathi., M. Pharma., Ph. D.,
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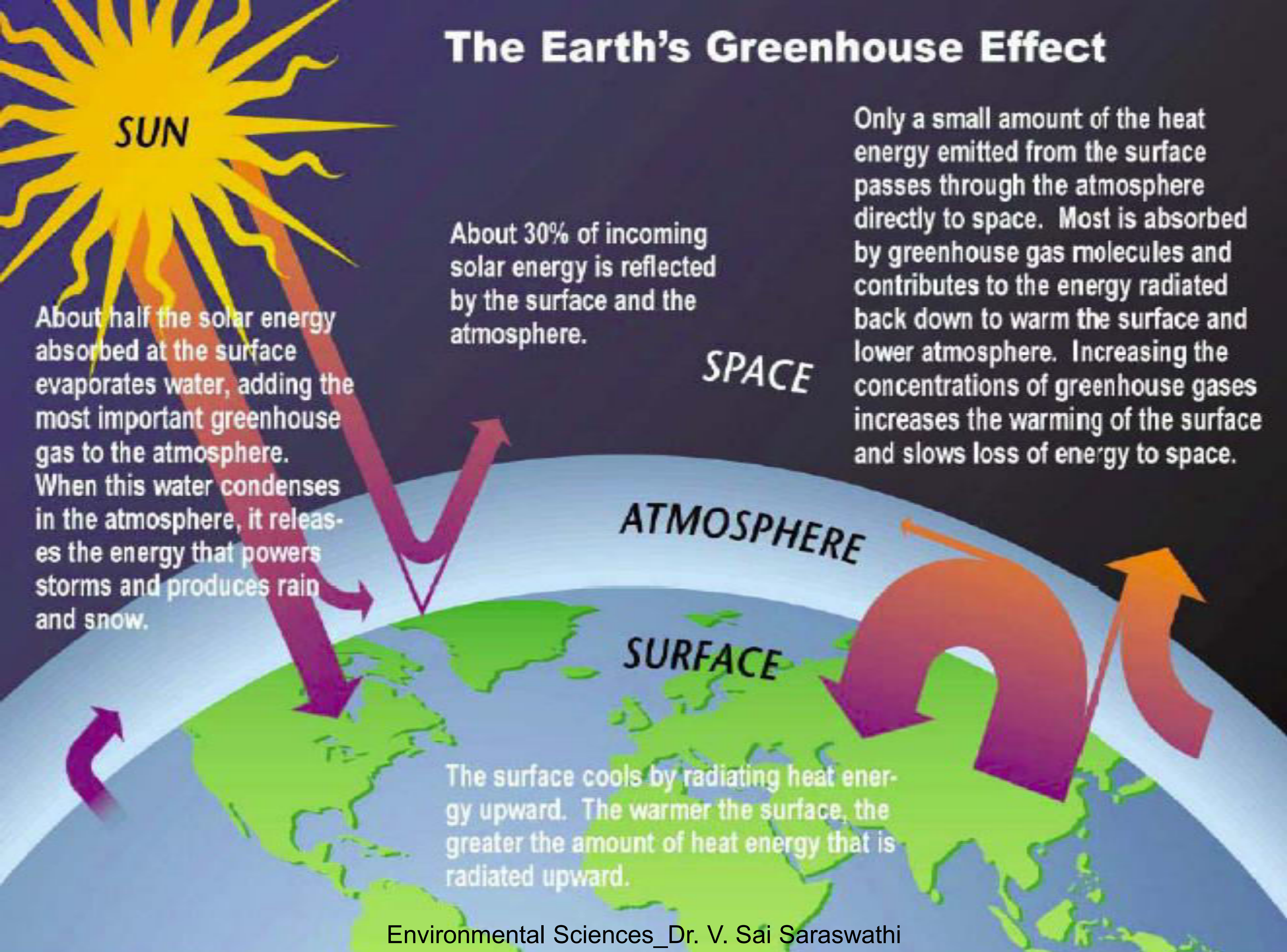
School of Advanced Sciences
VIT University, Vellore- 632014

Observed Changes and Effects


The Earth's Greenhouse Effect
SUN
About half the solar energy absorbed at the surface evaporates water, adding the most important greenhouse gas to the atmosphere. When this water condenses in the atmosphere, it releases the energy that powers storms and produces rain and snow.
About 30% of incoming solar energy is reflected by the surface and the atmosphere.
SPACE
Only a small amount of the heat energy emitted from the surface passes through the atmosphere directly to space. Most is absorbed by greenhouse gas molecules and contributes to the energy radiated back down to warm the surface and lower atmosphere. Increasing the concentrations of greenhouse gases increases the warming of the surface and slows loss of energy to space.
ATMOSPHERE
SURFACE
The surface cools by radiating heat energy upward. The warmer the surface, the greater the amount of heat energy that is radiated upward.

GLOBAL CLIMATE CHANGE

What is it?

Introduction

- **Climate change** is a change in the statistical distribution of weather over periods of time that range from decades to millions of years.
- May be specific in some areas.

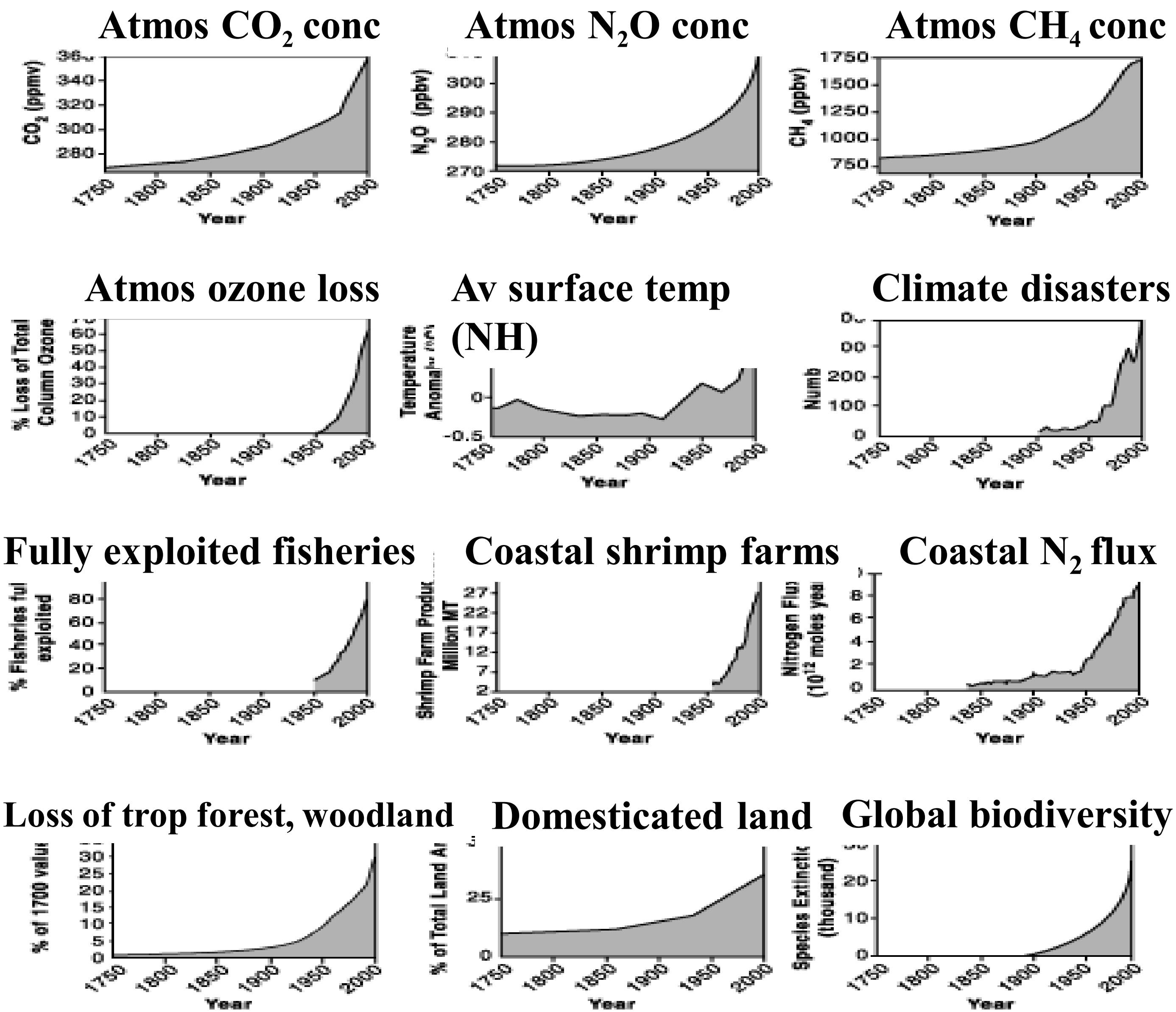
Climate Change: Basic Issues

- Earth's climate varies naturally – because of a variety of cosmological and geological processes.
- "Climate change" refers to an *additional*, and relatively rapid, change induced by human actions.
- The additional change – several degrees C within a century – will disrupt the foundations of life on Earth.
- Ecosystems and life in general have evolved within a narrow band of climatic-environmental conditions.

Causes of Change

Most of the observed increase in global average temperature since the mid-20th century is very likely due to the observed increase in human-caused greenhouse gas concentrations and human influences too.

Changes in environmental indicators, 1750 - 2000



From: Steffen et al. In press 2004

GLOBAL CLIMATE CHANGE

What's going to happen?

Agricultural Lands | Coastal Zones | Forest Lands | Freshwater Systems | Arid Lands & Grasslands

Food and Fiber Production
Provision of Clean and Sufficient Water
Maintenance of Biodiversity
Maintenance of Human Health
Storage and cycling of Carbon, Nitrogen, Phosphorus

Climate change will affect the ability of ecological systems to provide a range of essential ecological goods and services

World **Population 6,056,528,577**

The Challenge: Sustainable Management of an Ever-Changing Planet

Food production needs to double to meet the needs of an additional 3 billion people in the next 30 years

Climate change is projected to decrease agricultural productivity in the tropics and sub-tropics for almost any amount of warming

Wood fuel is the only source of fuel for one third of the world's population

Wood demand will double in the next 50 years

Forest management will become more difficult due to an increase in pests and fires

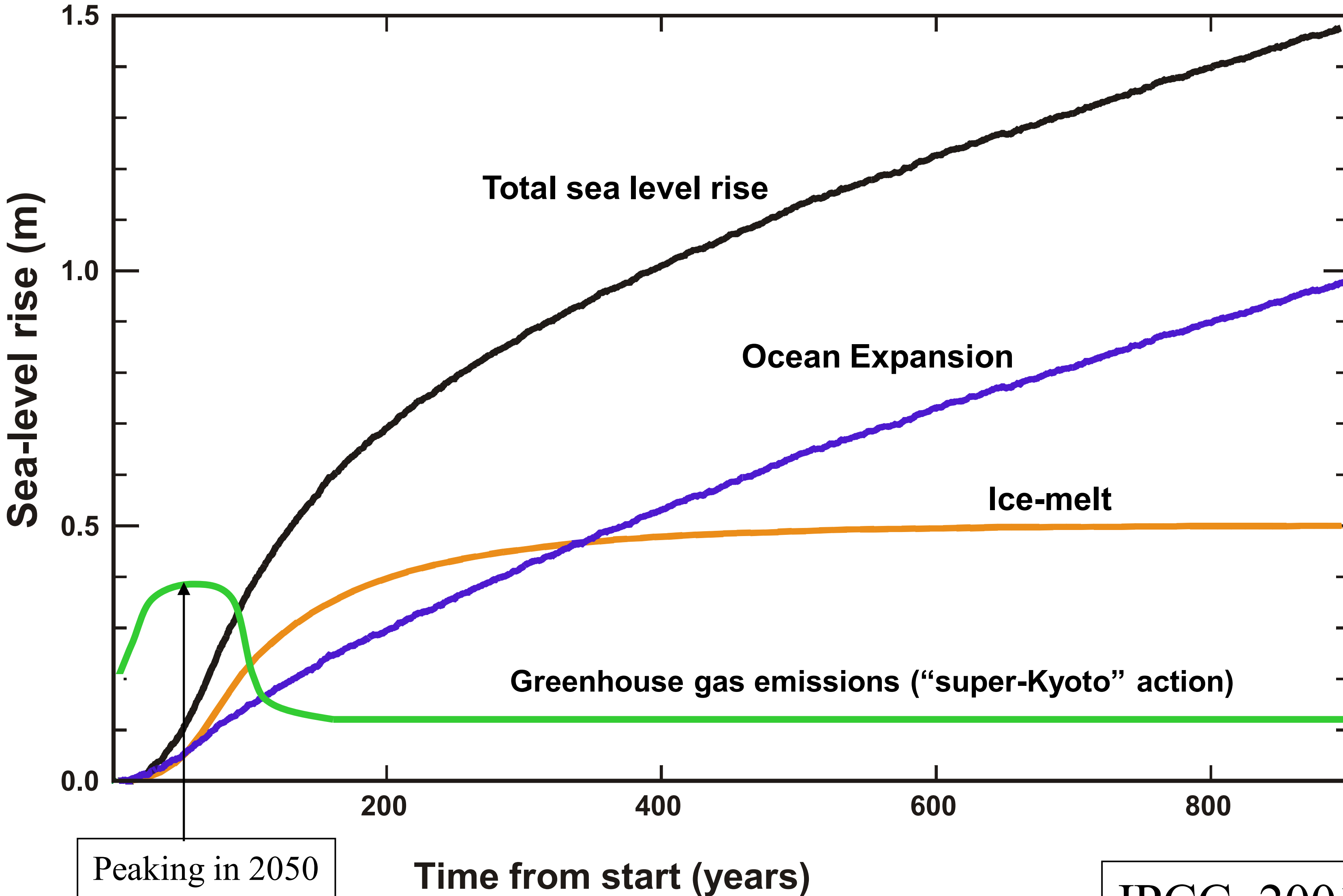
Climate change is projected to decrease water availability in many arid- and semi-arid regions

One third of the world's population is now subject to water scarcity

Biodiversity underlies all ecological goods and services

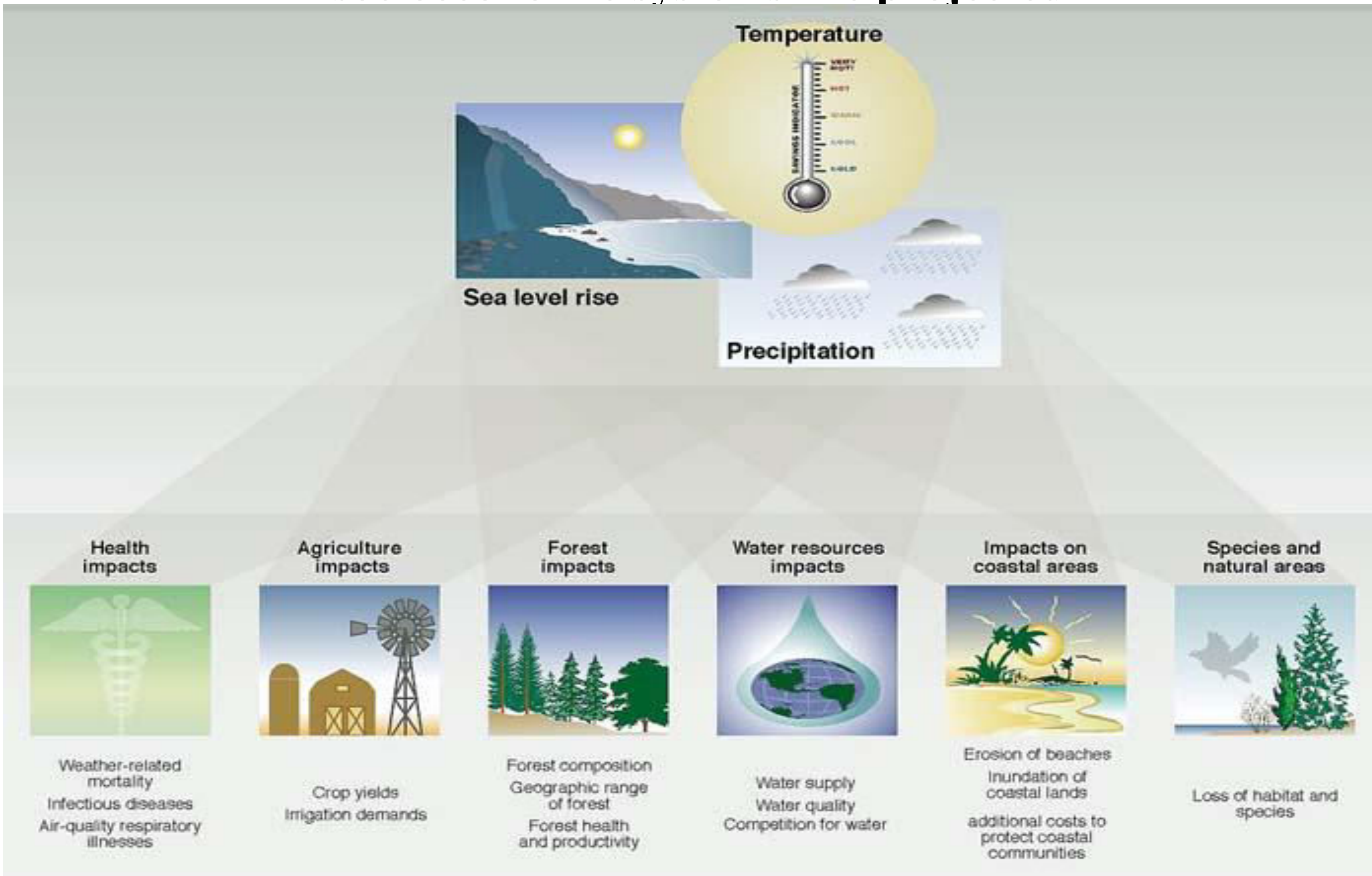
Climate change will exacerbate the loss of biodiversity

Sea-Level Rise, over the coming millennium



IPCC, 2001

More adverse than beneficial impacts on biological and socioeconomic systems are projected



Other Causes

- Plate tectonics
- Solar output
- Sudden shift in climate
- Volcanism
- Ocean Variability
- Human Influences

Changes in climatic phenomenon	Confidence in observed changes (latter half of 1900s)	Probability of projected changes to 2100
Higher maximum temperatures - more hot days	Likely	Very likely
Higher minimum temperatures, - fewer cold days and frost days	Very likely	Very likely
Increase of heat index over land areas	Likely	Very likely
More intense precipitation events	Likely, (N mid to high latitudes)	Very likely
Increased summer continental drying and associated risk of drought	Likely, in a few areas	Likely, over most mid-latitude continental interiors.
Increase in tropical cyclone peak wind intensities	Not observed in the few analysis available	Likely, over some areas
Increase in tropical cyclone mean and peak precipitation intensities	Insufficient data	Likely, over some areas

Risks to Small Island-States

- Coastal flooding/Storm.
- Damaged coastal infrastructure (roads, etc.)
- Salination of island fresh-water (esp. subterranean cells).
- Impaired crop production.
- Population displacement: diverse health risks (nutrition, infection, mental health)

Current Programs to Address Climate Change

International

- **Kyoto Protocol** emission targets — went into effect on February 16, 2005 without US participation
- Cities for Climate Change Protection - milestones

National

- Research
- Other States – Climate Action Plans.

GLOBAL CLIMATE CHANGE

So.. What can we do?

Environmental Sciences_Dr. V. Sai Saraswathi

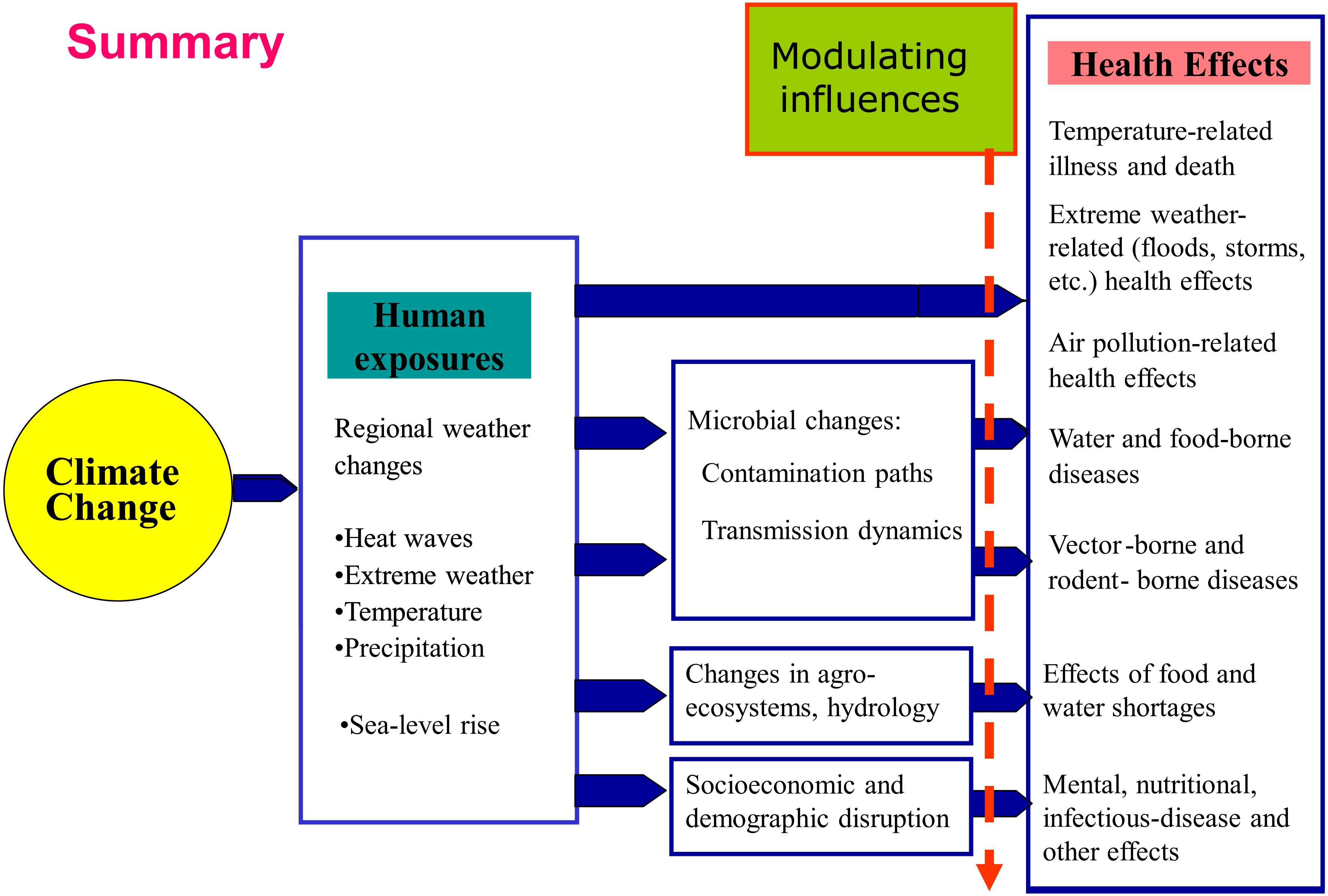
- Reduce emissions of greenhouse gases.
- Attempt to develop alternatives energies.
- Allow emission to continue, but prepare for global climate changes.
- Allow emissions to continue as normal and leave preparations up to individual countries
- Combine any of these ideas
- Come up with your own unique plan!

Potential mitigation technologies and practices

Sectors Potential activities

- **Energy supply:** Fuel switch.
- **Transport:** Vehicle efficiency, hybrid vehicles, biofuels, modal shift, planning.
- **Buildings:** Efficient lighting, appliances, Acs, improved insulation, solarheating and cooling, alternatives of Fluorinated gases.
- **Industry:** Heat & power recovery, recycling, emission control
- **Agriculture** Land mgmt, restoration of degraded lands, improved cultivation techniques, improved fertilizer applications
- **Forests:** Forest mgmt, reduced deforestation, Forestry product use for bioenergy.
- **Waste**: LF methane recovery, waste incineration and energy recovery, composting, recycling & waste minimization

Summary


Modulating influences
Health Effects
Temperature-related illness and death
Extreme weather-related (floods, storms, etc.) health effects
Air pollution-related health effects
Water and food-borne diseases
Vector-borne and rodent- borne diseases
Effects of food and water shortages
Mental, nutritional, infectious-disease and other effects
Human exposures
Regional weather changes
•Heat waves
•Extreme weather
•Temperature
•Precipitation
•Sea-level rise
Climate Change
Microbial changes:
Contamination paths
Transmission dynamics
Changes in agro-ecosystems, hydrology
Socioeconomic and demographic disruption

Thank You

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

Kyoto Protocol

INTERNATIONAL AGREEMENT- CLIMATE CHANGE (197 COUNTRIES)

Prof. V. Sai Saraswathi.,
Asst. Prof. (Sr.)
VIT University

Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which **commits** its Parties by setting internationally binding emission reduction targets.

Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities."

The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and are referred to as the "Marrakesh Accords." Its first commitment period started in 2008 and ended in

2012.

The Kyoto mechanisms

Under the Protocol, countries must meet their targets primarily through national measures. However, the Protocol also offers them an additional means to meet their targets by way of three market-basedmechanisms.

The Kyoto mechanisms are:

- International Emissions Trading
- Clean Development Mechanism (CDM)
- Joint implementation (JI)

The mechanisms help to stimulate green investment and help Parties meet their emission targets in a cost-effective way.

Monitoring emission targets

Under the Protocol, countries' actual emissions have to be monitored and precise records have to be kept of the trades carried out.

Registry systems track and record transactions by Parties under the mechanisms. The UN Climate Change Secretariat, based in Bonn, Germany, keeps an international transaction log to verify that transactions are consistent with the rules of the Protocol.

Reporting is done by Parties by submitting annual emission inventories and national reports under the Protocol at regular intervals.

A compliance system ensures that Parties are meeting their commitments and helps them to meet their commitments if they have problems doing so.

Adaptation

The Kyoto Protocol, like the Convention, is also designed to assist countries in adapting to the adverse effects of climate change. It facilitates the development and deployment of technologies that can help increase resilience to the impacts of climate change.

The Adaptation Fund was established to finance adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol. In the first commitment period, the Fund was financed mainly with a share of proceeds from CDM project activities. In Doha, in 2012, it was decided that for the second commitment period, international emissions trading and joint implementation would also provide the Adaptation Fund with a 2 percent share of proceeds.

The road ahead

The Kyoto Protocol is seen as an important first step towards a truly global emission reduction regime that will stabilize GHG emissions, and can provide the architecture for the future international agreement on climate change.

In Durban, the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) was established to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention, applicable to all Parties. The ADP is to complete its work as early as possible, but no later than 2015, in order to adopt this protocol, legal instrument or agreed outcome with legal force at the twenty-first session of the Conference of the Parties and for it to come into effect and be implemented from 2020.

International Emissions Trading

Greenhouse gas emissions – a new commodity

Parties with commitments under the Kyoto Protocol (Annex B Parties) have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions, or "assigned amounts," over the 2008-2012 commitment period. The allowed emissions are divided into "assigned amount units" **(AAUs).**

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare - emissions permitted them but not "used" - to sell this excess capacity to countries that are over their targets.
Thus, a new commodity was created in the form of emission reductions or removals. Since carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon. Carbon is now tracked and traded like any other commodity. This is known as the "carbon market."

Other trading units in the carbon market

More than actual emissions units can be traded and sold under the

Kyoto Protocol’s emissions trading scheme.

The other units which may be transferred under the scheme, each equal to one tonne of CO_2, may be in the form of:

- A removal unit **(RMU)** on the basis of land use, land-use change and forestry (LULUCF)activities such as reforestation
- An emission reduction unit **(ERU)** generated by a joint implementation project
- A certified emission reduction **(CER)** generated from a clean development mechanism project activity

Transfers and acquisitions of these units are tracked and recorded through the registry systems under the Kyoto Protocol. An international transaction log ensures secure transfer of emission reduction units between countries.

The commitment period reserve

In order to address the concern that Parties could "oversell" units, and subsequently be unable to meet their own emissions targets, each Party is required to maintain a reserve of ERUs, CERs, AAUs and/or RMUs in its national registry. This reserve, known as the "commitment period reserve", should not drop below 90 per cent of the Party's assigned amount or 100 per cent of five times its most recently reviewed inventory, whichever is lowest

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Relationship to domestic and regional emissions trading schemes

Emissions trading schemes may be established as climate policy instruments at the national level and the regional level. Under such schemes, governments set emissions obligations to be reached by the participating entities. The European Union emissions trading scheme is the largest in operation.

Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO_2, which can be counted towards meeting Kyoto targets.

The mechanism is seen by many as a trailblazer. It is the first global, environmental investment and credit scheme of its kind, providing a standardized emissions offset instrument, CERs.

A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient boilers.

The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets.

For more information about offsetting with CDM projects, visit Climate Neutral Now.

Operating details of the CDM

A CDM project must provide emission reductions that are additional to what would otherwise have occurred. The projects must qualify through a rigorous and public registration and issuance process. Approval is given by the Designated National Authorities. Public funding for CDM project activities must not result in the diversion of official development assistance.

The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol.

Operational since the beginning of 2006, the mechanism has already registered more than 1,650 projects and is anticipated to produce CERs amounting to more than 2.9 billion tonnes of CO_2 equivalent in the first commitment period of the Kyoto Protocol, 2008–2012.

Joint Implementation (JI)

The mechanism known as "joint implementation," defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO_2, which can be counted towards meeting its Kyoto target.

Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.

Eligibility and approval

A JI project must provide a reduction in emissions by sources, or an enhancement of removals by sinks, that is additional to what would otherwise have occurred. Projects must have approval of the host Party and participants have to be authorized to participate by a Party involved in the project.

Projects starting as from the year 2000 may be eligible as JI projects if they meet the relevant requirements, but ERUs may only be issued for a crediting period starting after the beginning of 2008.

Track 1 and Track 2 procedures

If a host Party meets all of the eligibility requirements to transfer and/or acquire ERUs, it may verify emission reductions or enhancements of removals from a JI project as being additional to any that would otherwise occur. Upon such verification, the host Party may issue the appropriate quantity of ERUs. This procedure is commonly referred to as the "Track 1" procedure."

If a host Party does not meet all, but only a limited set of eligibility requirements, verification of emission reductions or enhancements of removals as being additional has to be done through the verification procedure under the Joint Implementation Supervisory Committee (JISC). Under this so-called "Track 2" procedure, an independent entity accredited by the JISC has to determine whether the relevant requirements have been met before the host Party can issue and transfer ERUs.

A host Party which meets all the eligibility requirements may at any time choose to use the verification procedure under the JISC (Track 2 procedure).

Reference

http://unfccc.int/kyoto_protocol

The Montreal Protocol

Dr. V. Sai Saraswathi.,
Environmental Professor, VIT University, Vellore-14

The Montreal Protocol on Substances that Deplete the Ozone Layer is the landmark multilateral environmental agreement that regulates the production and consumption of nearly 100 man-made chemicals referred to as ***ozone depleting substances (ODS).*** When released to the atmosphere, those chemicals damage the stratospheric ozone layer, Earth's protective shield that protects humans and the environment from harmful levels of ultraviolet radiation from the sun. Adopted on ***15 September 1987***, the Protocol is to date the only UN treaty ever that has been ratified every country on Earth - all **197 UN Member States**.

The Montreal Protocol phases down the consumption and production of the different ODS in a step-wise manner, with different timetables for developed and developing countries (referred to as "Article 5 countries"). Under this treaty, all parties have specific responsibilities related to the phase out of the **different groups of ODS, control of ODS trade, annual reporting of data, national licensing systems to control ODS imports and exports, and other matters**. Developing and developed countries have equal but differentiated responsibilities, but most importantly, both groups of countries have binding, time-targeted and measurable commitments.

The Protocol includes provisions related to Control Measures (Article 2), Calculation of control levels (Article 3), Control of trade with non-Parties (Article 4), Special situation of developing countries (Article 5), Reporting of data (Article 7), Non-compliance (Article 8), Technical assistance (Article 10), as well as other topics. The substances controlled by the treaty are listed in Annexes A (CFCs, halons), B (other fully halogenated CFCs,

carbon tetrachloride, methyl chloroform), C (HCFCs), E (methyl bromide) and F (HFCs).

The treaty evolves over time in light of new scientific, technical and economic developments, and it continues to be amended and adjusted. The Meeting of the Parties is the governance body for the treaty, with technical support provided by an Open-ended Working Group, both of which meet on an annual basis. The Parties are assisted by the Ozone Secretariat, which is based at UN Environment Programme headquarters in Nairobi, Kenya.

Phase out of HCFCs – the Montreal Amendment

Hydrochlorofluorocarbons (HCFCs) are gases used worldwide in **refrigeration, air-conditioning and foam applications**, but they are being phased out under the Montreal Protocol since deplete the ozone layer. HCFCs are both ODS and powerful greenhouse gases: the most commonly used HCFC is nearly 2,000 times more potent than carbon dioxide in terms of its global warming potential (GWP).

Recognizing the potential benefits to the Earth's climate, in September 2007 the Parties decided to accelerate their schedule to phase out HCFCs. Developed countries have been reducing their consumption of HCFCs and will completely phase them out by 2020. Developing countries agreed to start their phase out process in 2013 and are now following a stepwise reduction until the ***complete phase-out of HCFCs by 2030.***

In Article 5 countries, this HCFC phase out is in full swing, with support from the Multilateral Fund for the implementation of multi-stage **HCFC Phase out Management Plans (HPMPs),** investment projects and capacity building activities. Throughout this process, the Parties are encouraging all countries to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations. For the climate consideration, this means taking global-warming potential, energy use and other relevant factors into account. For refrigeration and air conditioning, this means optimizing refrigerants, equipment, servicing practices, recovery, recycling and disposal at end of life.

Reference: UN- Newsroom