

2nd Edition

Disasters and the Environment



■ Disaster Management Training Programme

Disasters and the Environment

2nd Edition

Module prepared by

Gustavo Wilches and
InterWorks



DHA

Disaster Management Training Programme

1995

The first edition of this module was printed in 1993. Utilization and duplication of the material in this module is permissible; however, source attribution to the Disaster Management Training Programme (DMTP) is required.

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United Nations reorganization and the Disaster Management Training Programme

Since this module was written there has been reorganization within the United Nations system. This page is inserted to alert you to the organizational changes and explain the expanded role of the United Nations in disaster management. All module references to UNDRO (Office of the United Nations Disaster Relief Co-ordinator) Should now be read as DHA (Department of Humanitarian Affairs).

Following the adoption of General Assembly resolution 46/182, the UN Secretary-General established in April 1992 the Department of Humanitarian Affairs (DHA) in order to strengthen and make more effective the collective efforts of the international community, and particularly those of the United Nations System, in providing humanitarian assistance. The Emergency Relief Co-ordinator, as Under-Secretary-General for Humanitarian Affairs, directs the Department's efforts to ensure both a rapid, integrated and effective international response to humanitarian emergencies, and the implementation of measures for disaster preparedness, prevention and mitigation.

As the UN's lead body for humanitarian co-ordination, DHA operates in the grey zone where security, political and humanitarian concerns converge. The Department has Offices in both New York and Geneva with distinct, though mutually-reinforcing, responsibilities.

The Department focuses in New York on the formulation of policy as well as policy co-ordination, policy planning and early warning functions. This requires the Department to work closely with the deliberative organs of the UN as well as with the political, financial and economic departments of the UN Secretariat to ensure vertical co-ordination.

The Geneva Office (DHA-Geneva) concentrates its activities on providing operational support during emergencies and on co-ordinating international disaster relief activities, as well as all activities related to disaster prevention and mitigation.

An Inter-Agency Standing Committee (IASC) chaired by the Under Secretary-General for Humanitarian Affairs has been established pursuant to General Assembly resolution 46/182. It associates non-governmental organizations, UN organizations, as well as the International Committee of the Red Cross (ICRC) and the International Federation of Red Cross and Red Crescent Societies (IFRC). The executive heads of these agencies meet regularly to discuss issues relating to humanitarian emergencies. An inter-agency secretariat for the IASC has also been established within DHA.

As part of the reorganization of DHA, the Special Emergency Programmes (SEP) were consolidated into the Complex Emergency Division (CED), with a desk structure in New York and a support unit in Geneva. CED comprises the former Special Emergency Programme for the Horn of Africa (SEPHA), the Drought Emergency in Southern Africa Programme (DESA), the Special Emergency Programme for Newly Independent States (SEP-NIS), the Special

Humanitarian Programme for Iraq (SEP-IRQ) as well as the United Nations Office for the Co-ordination of Humanitarian Assistance to Afghanistan (UNOCHA).

A number of staff members were transferred to New York from Geneva as part of this reorganization. A Complex Emergency Support Unit was created in Geneva to handle liaison with Geneva-based government missions, UN Agencies, international organizations and NGOs to support Appeals preparation and finalization, dissemination of other information and financial tracking. Administrative matters related to CED field operations have also been handled by DHA in Geneva throughout 1994. During the year, DHA established field units in Rwanda, Armenia, Azerbaijan, Georgia and Tajikistan. The humanitarian needs which arose from the events in Chechnya, Russian Federation, led to the establishment of a DHA presence in Moscow at the beginning of 1995.

DHA promotes and participates in the establishment of rapid emergency response systems which include networks of operators of relief resources, such as the International Search and Rescue Advisory Group (INSARAG). Special attention is given to activities undertaken to reduce the negative impact of sudden disasters within the context of the International Decade for Natural Disaster Reduction (IDNDR).

The Disaster Management Training Programme (DMTP), which was launched in the early 1990s, is managed jointly by DHA and UNDP on behalf of an inter-Agency Task Force. It provides a framework within which countries and institutions (international, regional and national) acquire the means to increase their capacity-building in emergency management in a development context.

■ INTRODUCTION

Purpose and scope

Are we blameless victims of disaster? Or do imbalances in the environment – caused by human population pressures and economic trends – increase our vulnerability to disaster, as recent evidence shows?

This module looks at disasters from an environmental point of view. It examines how environmental degradation of the earth's ecosystems increases a society's vulnerability to disaster and how disasters alter the environment. Using this environmental awareness, we can focus our development efforts toward mitigating and preventing disasters.

Disasters: natural or human-made

Disasters occur when hazards meet vulnerable situations. Natural hazards, such as fires, floods, earthquakes and drought, are part of the natural cycles of the earth. When such hazards impact on vulnerable societies – whether it is an earthquake that collapses buildings, or a drought that kills crops – that society may face a catastrophic situation requiring emergency relief and assistance to save lives and to protect the environment.

The distinction between natural and human-made hazards is becoming blurred. Human-made hazards, such as technological and chemical accidents, air and water pollution and desertification, degrade the environment and can lead to disaster. Hazards once considered natural and unavoidable are now thought to be partly due to human-induced environmental change. For example, research shows that in many parts of the world, an increase in flooding is linked to the escalating rate of deforestation in those areas.

As economies grow and technology expands, human-made disasters will increase. Even disasters resulting from sudden natural hazards such as earthquakes, tsunamis, volcanic eruptions or flash flooding may be partly attributable to us, when we build unsafe settlements close to hazardous areas. Rapid population growth increases the demand for natural resources, placing pressure on the environment and raising the risk that a hazard will cause a disaster, and, furthermore, that disasters will occur more frequently.

As economies grow and technology expands, human-made disasters will increase.

Vulnerability + Hazard = Disaster Risk

The Mathematics of Disasters

A society's vulnerability to disaster is the degree to which it is likely to be damaged or disrupted by the impact of a hazard. Such vulnerability is often difficult to quantify. Measuring the monetary losses of sudden-onset disasters is easier than measuring the social losses, although both are important; the long-term effects of disasters on the economy are also difficult to assess.

With slow-onset hazards – such as drought, desertification, and environmental pollution - where other factors come into play, assessments are particularly hard, especially in developing countries. For instance, low rainfall and water scarcity in Africa is often compounded by other problems, such as deforestation, rural poverty, soil erosion, poor agricultural practices, and uncertain land tenure. In general, vulnerability is closely associated with poverty and, in that sense, developing countries are highly vulnerable.

Overview of this module

We are invariably connected with disasters. It follows, therefore, that we can also work to prevent disasters. Through active prevention and mitigation measure, which plan for and limit the harmful environmental effects of population growth and economic development, we can reduce our vulnerability to disasters.

Part 1 of this module describes the earth's systems and explains the degradation occurring within each system. The potential dangers to human, animal and plant life are also discussed.

Part 2 details the major human made forces that impact the environment and demonstrates how these forces increase vulnerability to 13 major human-made and natural hazards.

Part 3 identifies the linkages between disaster mitigation, environmental management and sustainable development.

Part 4 focuses on the priorities for national programs such as human development, economic development and environmental protection and suggests action to mitigate environmental degradation.

Part 5 reviews environmental management tools designed for use in UNDP programs. The roles of UN organizations and other agencies in implementing environmental programs are described.

Training methods

This module is intended for two audiences: the self-study learner and the participant in a training workshop. The following training methods are planned for use in workshops and are simulated in the accompanying “training guide”. For the self-study learner the text is as close to a tutor as can be managed in print.

Workshop training methods include:

- group discussions
- simulations/role plays
- supplementary handouts
- videos
- review session
- self-assessment exercises



The self-study learner is invited to use this text as a workbook. In addition to note-taking in the margins, you will be given the opportunity to stop and examine your learning along the way through questions included in the text. Write down your answers to these questions before proceeding to ensure that you have captured key points in the text.



PART 1

THE EARTH AS A SYSTEM

This part of the module is designed to:

- Describe the interaction of the earth's systems.
- Identify how changes in one system affects other systems.
- Show how environmental degradation is related to hazards and disasters.

Studying the environment

What is the environment? The environment can be defined as the sum total of all conditions affecting the existence, growth and welfare of an organism or group of organisms on earth. Every single element of our daily lives is part of the environment, including the air we breathe, the condition of our bodies, every single item in our homes, and every bit of food and water we consume. The wide scope of this definition makes the environment difficult to study, but certain study methods can help us make the connection between disasters and the environment.

Studying the environment involves two basic approaches. The first approach – based on the fact that humans share this planet with other living creatures – focuses on the interactions among living systems. The second, broader approach looks at the total environment and emphasizes that all the planet's resources, both living and non-living, are ultimately limited. With both approaches, however, the human species is the central player, because human welfare and activities are foremost in our attention.

The science of ecology is the study of the interrelationships of organisms and their physical environment; this is a useful tool for examining how natural systems operate and for discovering what affects them. An ecological system (ecosystem) is a collection of organisms and their environment. Within the global environment exist many ecosystems and environments. For example, a tree, a lake, or a human settlement can be studied as separate ecosystems. Within the framework of this module, one modern perspective of ecology is especially helpful: the growing awareness that shortages of food and space will pressure human society to change and limit its activities.

Q. *What aspects of human existence are not directly or indirectly related to the environment?*

A. _____

LEARNING OBJECTIVES

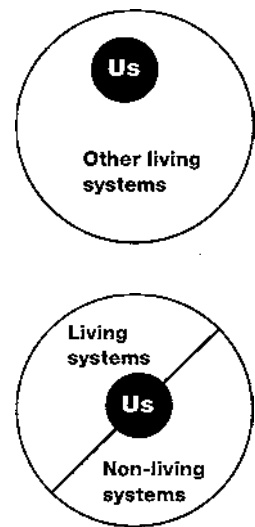


Figure 1
Two approaches to studying the environment

ECOLOGY



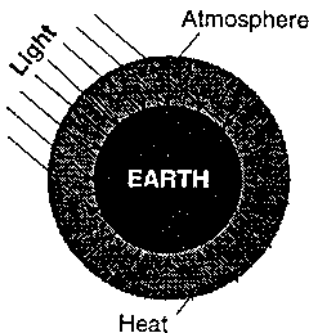


Figure 2
Reflection of radiation from the earth's surface

The earth's systems

The atmosphere

The atmosphere is an envelope of gases surrounding the earth. When the sun's radiation enters the atmosphere, some of that radiation is reflected back into space by clouds and dust, and some travels to the earth's surface, where it is absorbed or reflected back to space by such reflective surfaces as ice, snow and water.

The earth also emits infrared radiation, which is thermal, or heat, radiation. Certain atmospheric gases do not allow this longer-wave, infrared radiation to escape; it bounces back to earth, where it raises the surface temperature. This is known as the greenhouse effect. Without the greenhouse effect, the earth would be much cooler; many forms of life would not exist. The gases that make up the atmosphere – including nitrogen, oxygen, argon, carbon dioxide, methane and ozone – regulate and balance the energy contained and released.

The oceans (Hydrosphere)

The oceans and other large bodies of water hold heat absorbed from solar radiation longer than land. Currents circulate this heat vertically, from the surface to deeper waters, and horizontally, from high to low latitudes and across the longitudes. When this heat is released, often at a great distance from where it was absorbed, its interaction with the atmosphere produces the daily and seasonal cycles and temperatures affecting local climatic conditions.

The water (hydrological) cycles

The water resources of earth are continually being recycled, driven mainly by the force of gravity and by energy from the sun. Precipitation, in the form of rain or snow, is the major source of moisture for the earth's hydrological systems, although fog and dew may be important in certain regions. Rain falling on the oceans evaporates, forming clouds that produce more rain; some of the rain that falls on the vegetation cover, bare ground or on lakes and rivers also evaporates.

Water that enters the ground is either absorbed by plants' root systems, or it percolates down through the soil to reappear later in seepage to streams and rivers, lakes, or oceans. Water may spend hundreds or even thousands of years in the ground.

The land (Lithosphere)

The land is also called the lithosphere, or the earth's crust, which supports a wide variety of unique ecosystems, ranging from arid areas to tropical forests. Each ecosystem is composed of distinct plants, animals, soils and nutrients that form interdependent systems.

Over time, ecosystems change, both as plant and animal life evolve and with events such as drought and flooding. On a scale of thousands of years, ecosystems have changed with the earth's glacial cycles, and the earth's surface alters through earthquakes and volcanic activity.

ANSWER (from page 13)
None

Biosphere

The biosphere is defined as the space on earth – within the atmosphere, the hydrosphere and the lithosphere – where life has developed. It consists of the soil and upper part of the earth’s crust, the lower layers of the atmosphere, and the hydrosphere.

The biosphere may be thought of as common ground shared by humans, plants, birds, fish, bacteria and wild and domesticated animals. All ecosystems are combined in the biosphere, which has a self-regulating capability. If changes in the biosphere occur, however – physical and chemical changes to which organisms cannot adapt – then the ability of these organisms to absorb substances, to grow, and to reproduce is affected.

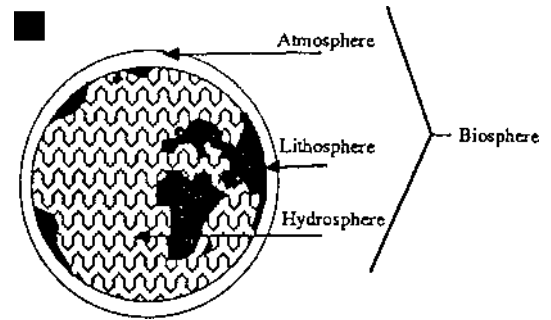


Figure 3
The biosphere

Interactions of the earth’s systems: environmental degradation

The components of the earth’s systems – the atmosphere, oceans, and living species – are intricately intertwined. If one part of the earth changes, other parts will be affected – often in ways that are not immediately obvious. For example, removing vegetation from an area of land decreases that land’s absorption of ground water, resulting in possible drinking water shortages for the inhabitants. Or the burning of tropical woodlands can increase the amount of carbon dioxide in the atmosphere. In this section, we illustrate the major concerns of environmental degradation.

Degradation of the atmosphere

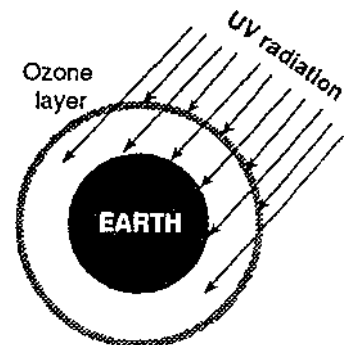
Global warming – The concentration of carbon dioxide in the atmosphere has increased nearly 25 percent since the onset of industrialization in the 18th century. To meet the world’s energy needs, the burning of fossil fuels – such as coal, wood and petroleum – frees carbon to join with oxygen in the atmosphere. Deforestation, the destruction of forests by burning or over-logging (see **Deforestation** below), also contributes to the build-up of carbon dioxide by releasing carbon stored in the plant material.

Atmospheric methane, released from landfills, cattle and fermenting rice paddies has increased with population growth. The build-up of these greenhouse gases may enhance the natural greenhouse effect and may result in additional warming of the earth’s surface, or **global warming**. If warming occurs as some scientists predict, the results might include a rise in the sea level, changes in climate, changes in ecosystems, and impacts on public health.

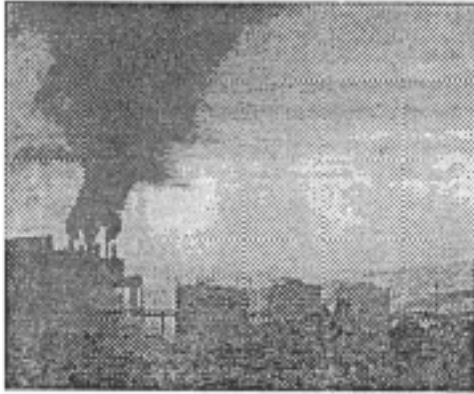
Ozone depletion – Ozone, a rare form of oxygen, is concentrated in the upper atmosphere or ozonosphere, located 11 to 24 km above the earth. This ozone layer, which protects life from the damaging rays of the sun, is being thinned by the release of chlorofluorocarbons (CFCs), chemicals used in refrigeration, foam products and aerosol propellants.

Many forms of life will be affected as the ozone layer thins and more ultraviolet light reaches the earth. In humans, skin cancer and diseases of the eyes and immune systems are expected to increase. Ultraviolet radiation can penetrate the oceans’ surface, damaging fish and the phytoplankton base of the food chain, possibly impacting significantly on fish-eating populations.

Figure 4
The ozone layer



Air pollution – Most of the world’s urban dwellers breathe polluted air at least part of the time. Sulfur dioxide (SO₂), a major pollutant, is a corrosive and harmful to humans and the environment. The burning of fossil fuels, to generate electricity, is a key source of sulfur dioxide; in developing countries, burning coal and wood also contributes. Other air pollutants include nitrous oxides, carbon monoxide, carbon dioxide and lead from vehicle exhaust. In some countries, particulate matter such as dust, dirt and smoke cloud the air.



Audubon, May-June 1992

Air pollution inflicts further damage on land and water systems: on agricultural crops, forests, rivers and lakes, buildings and human health. Such airborne pollution damages crops and vegetation by injuring the plant tissue, which increases susceptibility to disease and drought. Human health also suffers when pollution damages respiratory tracts.

As primary pollutants react to form secondary pollutants, acidic compounds are sometimes created. When these acidic compounds and other multiple pollutants damage the foliage and the soil, forests decline and die (see **Deforestation** below). Pollutants in the air are also dissolved in water droplets and held in clouds, sometimes moving long distances before falling back to earth in acid rain, snow, dew or fog.

Degradation of the oceans

Marine pollution – Due to their enormous volume, oceans are frequently used as disposal areas for human societies’ garbage. Raw sewage, consisting of human excreta and domestic wastes, is the major source of ocean pollution. Sewage, livestock waste and fertilizer runoff also make bodies of water over-rich in dissolved nutrients, a process called eutrophication; this phenomenon depletes the water of oxygen, killing fish and other marine life. Other causes of degradation: litter dumped from ships, petroleum spills, and the dumping of radioactive substances.



Local volunteers and professionals clean up debris near Huntington Beach, California, after a 1990 oil spill.

Audubon, May-June 1992

Marine pollution can have major consequences:

- Human wastes contain disease-causing bacteria and viruses.
- Nondegradable materials injure and kill marine mammals.
- The spread of hazardous chemicals may damage the marine ecosystem and accumulate in seafood.

Ocean temperature shifts – Current warming trends in the earth’s atmosphere may affect the temperature of the oceans, which may increase the occurrence or severity of the El Niño phenomenon, an incursion of warm surface water near the coast of Peru.

Scientific evidence links El Niño events to droughts and heavy rains in a number of countries; these associations are a result of global patterns of atmospheric circulation. For example, the major drought of 1982-83 that affected Africa, India, northeast Brazil, the USA, Australia and Indonesia coincided with the most significant El Niño event ever recorded. A smaller El Niño in 1986-87 was associated with the drought in Ethiopia.

Degradation of the water cycles

The various subsystems of the hydrological cycle are so interrelated that interference with one will affect the others. We alter the natural flow of water with dams and reservoirs; we render the ground impermeable to moisture by covering it with concrete and buildings. Removing the soil's natural vegetation cover reduces the soil's ability to retain water; this causes rapid runoff of water to drainage areas, leaving less for local use by plants and humans.

When people consume vast amounts of water – for drinking, domestic use, irrigation and industry – the possibility increases that water shortages will occur in the future. Pollution of water by sewage, industrial wastes, pesticides and fertilizers increases the odds that supplies of clean water will not be adequate. Acid precipitation (see above) increases the acidity of the soils, lakes and streams where it falls and is often toxic to plants and animals.

■ CASE STUDY

Recycling wastewater in Peru

One of the most pressing problems facing cities in the developing world today is the disposal of human and industrial waste. Compounding this is the general scarcity of clean water, a situation that exists in Lima, Peru. Consequently, many urban poor in Lima use untreated wastewater to grow vegetables for human consumption. This practice has resulted in frequent outbreaks of typhoid and hepatitis and is the reason why Peru has one of the highest incidences of diarrheal disease in the world.

A pilot project was set up in a small Peruvian city by UNDP and the World Bank to promote methods of recycling wastewater in developing countries. Other contributors to the project were the Center for Sanitary Engineering and Environmental Sciences (CEPIS) based in Lima and GTZ, the technical assistance branch of the German government. The goal of the project has been to economically treat wastewater so it can be used for irrigation and fish production.

The subject city, San Juan de Miraflores, has a population of 150,000 and produces sewage at the rate of 360 liters per second. The sewage is collected in 21 waste stabilization ponds located downhill from the town. As the water flows downhill through the settling ponds, it loses some of its impurities and later is further cleaned through photosynthesis, produced by duckweed which feeds on waste matter. The parasites, viruses and solid organic matter remain on the pond beds. Fortunately, the water contains a very low level of detergents, for the removal process for detergents would be more complex.

Irrigation from the wastewater has covered an area of 1,500 hectares, where trees, maize, alfalfa, bananas, sweet potatoes and pecans are grown. Fish have been raised in water that has been sufficiently purified to meet WHO standards; prawns, carp and tilapia can also be raised.

The cost of this type of stabilization pond system is very reasonable and can pay for itself through the produce and fish. For developing countries, it seems a sensible approach, as it requires no imported equipment and very low



Fish harvested from purification ponds

UNDP photo by Julio Moscoso, Source, Dec. 1989

maintenance. The ponds from San Juan produce up to five tons of fish per hectare in winter and 13.5 tons per hectare in summer. Particularly in Lima, there is great demand for fish, which has become very expensive.

Future plans involve diverting and treating half of Lima’s wastewater to irrigate 5,000 hectares. If successful, the project could address some of Lima’s problems, which include poor health and nutrition in the shanty towns – the poor are often forced to buy water from trucks but cannot afford to buy enough to irrigate crops.

Q. *How would you describe the water quality and quantity in your country? In the cities, in the countryside? What steps are being taken to improve the quality of the water, even if it is plentiful? Will there be enough for future generations?*

A. _____



In developing countries, 57% of the population will inhabit urban areas by the year 2025.

Degradation of the land

Human settlements, particularly in urban areas, cover the land with concrete, asphalt and other building materials; buildings and roads in urban areas reflect light and generate heat. Since such ground covers prevent the land from absorbing water, drains and other means must be employed for collection of water runoff, sewage and other toxic materials. In developing countries, according to the World Resources Institute, 57% of the population will inhabit urban areas by the year 2025, a sharp surge from 34% in 1990.

Deforestation –The forests of the world – trees and other vegetation – are being destroyed to make land available for agriculture and to meet demands for lumber and fuel. Yet trees provide great benefits to the biosphere –they recycle carbon dioxide into oxygen, release moisture to the air, trap nutrients in their root systems, stabilize the soil, provide habitats for species, and provide wood, food and medicinal products.

Deforestation of the tropical rain forests is an especially serious form of degradation. The rain forests are exceedingly complex ecosystems that are home to millions of unique species. The exceedingly rapid growth within the earth’s tropical rain forests, due to high temperatures and high rainfall amounts, contributes a large share of the earth’s biomass (i.e., plant materials and animal wastes that are used as fuel) while covering only 7 percent of the land area. Additionally, when the forests are cleared by burning, the fires contribute to carbon dioxide in the atmosphere.

Soil degradation – Water and wind erode the valuable topsoil of the earth; poor agricultural practices exhaust the soil's nutrients; and pollutants make the soil acidic and toxic. The trampling of livestock and machinery compact the soil and make it less permeable. Poorly managed irrigation can result in salinized and alkalized soils. About 9 million hectares of soil worldwide are irreversibly degraded.

Removal of vegetation and soil degradation are the causes of desertification – the loss of productivity of land (see Part 2). These factors also contribute to flooding, landslides, drought and famine, and fires.

Fuel crisis – Rural populations in developing countries depend on traditional biomass fuels – wood, charcoal, dung and crop residues – for energy. More than 50 million Africans already face acute wood fuel scarcities. Burning dung and crop residue prevents such materials' use as agricultural fertilizer, where they are needed to increase yields. Most of the commercial fuel used by developing countries is imported oil, which consumes a large percentage of national budgets.

Degradation of the biosphere

The degradation of the atmosphere, the hydrosphere and the lithosphere often lead to the degradation of the biosphere.

Loss of species and cultures – All over the world, urban development and deforestation seriously affect the ecosystems of plants, birds, animals and insects. Tropical forests are in the greatest danger, but other fragile ecosystems exist including wetlands, coral reefs, islands, temperate forests and mangrove swamps.

Many species have become extinct or are in danger of extinction as their habitats are destroyed; they are also killed for food or profit. Some estimates claim losses of 100 species per day. In addition, human cultures that have traditionally lived within special ecosystems, such as the tropical rain forests, are being phased out. The loss of forest products may include plants that can cure disease. Drugs such as quinine and reserpine are derived from rain forest species. There may well be others as yet undiscovered.

The loss of species and traditional cultures, although unquantifiable in monetary value, creates a void in scientific knowledge of biological evolution. In addition, other intangibles, such as beauty and diversity, are lost for future generations.

Toxic chemical contamination – The multitudes of toxic chemicals all over the world have led to degradation of ecosystems where those chemicals have been dumped or sprayed. Pesticides, herbicides and fertilizers, in particular, leach into soils and waters and affect the entire food chain. Industrial effluents are pumped into lakes, rivers and oceans, affecting the growth and reproductive cycles of aquatic organisms. Industrial accidents, involving spills of large quantities of toxic chemicals into the environment, are occurring with greater frequency.

About 9 million hectares of soil worldwide are irreversibly degraded.

Some estimations claim loss of 100 species per day.



Dr. Te-Tzu Chang in IRRI's germ-plasm bank.

UNDP photo by David Kinley
World Development, May 1990

■ CASE STUDY

Filling Asian rice bowls

The “Green Revolution” is in trouble. The new varieties of rice that boosted rice production in the 1960s and 1970s and dramatically increased yields, may not be able to keep pace with population growth. Asia’s rice-growing area has increased only 17% in the past 25 years, while average rice production has increased 72%. During this period, Asia’s population grew by 67%.

The rate of growth of Asian rice production in the 1970s fell from 3% per year to 2.2% in the 1980s. Economists and farmers give the following reasons for the decline:

- falling prices for rice
- high costs of fertilizers and pesticides
- pollution, flooding, salting of irrigation systems, and loss of topsoil
- land formerly devoted to rice production is now claimed for urban development and industrial parks

According to scientists at the International Rice Research Institute (IRRI) in the Philippines, a mere 5% decline in Asian rice production would absorb current world surpluses. Global demand for rice is predicted to rise from today’s level (460 million tons) to 560 million tons by the year 2000.

Meeting the demand will not be as simple as increasing yields. The phenomenal growth in production has already made demands on the environment and the economy by:

- increasing the use of fertilizer and pesticide, machinery and irrigation
- requiring some government subsidies
- degrading the soils through high intensity farming
- helping the development of resistant strains of plant pests

Further, major sectors of rice farmers have been overlooked. Those living in marginal areas use no irrigation and depend instead on monsoon rains. Most of the modern rice varieties are vulnerable to drought, flooding and salinity; as a result, farmers in these areas use traditional, low-yielding varieties that are locally adapted. IRRI now faces the challenge of uniting the hardiness of the traditional varieties with the productivity of the modern strains and passing this information on to farmers.

IRRI, located near Manila, is the site of a “germ plasm bank” – a vault in which 84,000 varieties of rice are hermetically maintained. These rice seeds have been collected from over 100 countries and are the basis for research upon which future Asian rice supplies may depend.

There are about 100,000 genes in any one plant of rice; the problem becomes one of identifying the 20 or so genes that need to be altered to produce the right characteristics. Some promising findings of the research program include:

- rice yields may be raised by 30 to 40 percent in 5-10 years
- new traits can be bred into the rice plants, such as resistance to drought flood, pests and other stresses
- biological alternatives to chemical fertilizers and pesticides can be found.

THE HUMAN DIMENSIONS OF ENVIRONMENTAL CHANGE

This part of the module:

- *Defines the human factors that affect the environment.*
- *Shows how these factors contribute to environmental degradation and vulnerability to disasters.*
- *Lists adverse effects of 13 hazards on the environment.*

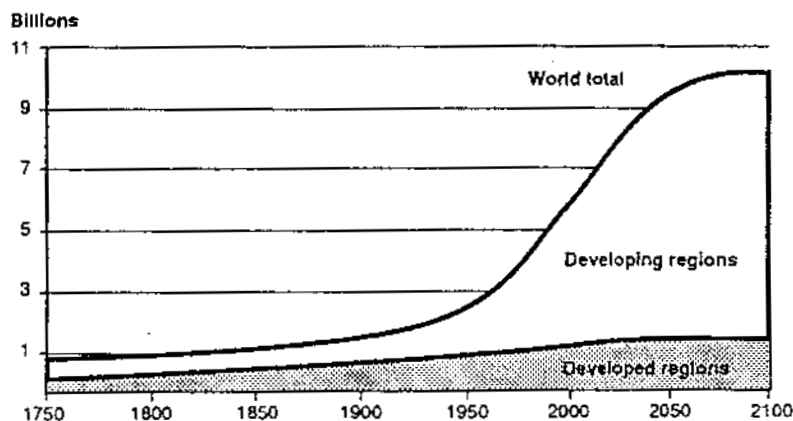
The impact of humanity

Humans began to alter the earth's environment thousands of years ago, first through the use of simple tools for hunting and gathering, and then later with more complex tools as plants were cultivated. All over the world, evidence exists of human intervention. Almost no remnants of the original vegetation remain around the Mediterranean Sea. In England, 90% of the forest has vanished. Brazil's Atlantic forest, which once covered a million square kilometers, is now only 7% of its original size.

The major driving forces which influence human interaction with the environment may be roughly grouped as shown below. A great deal remains unknown about the interrelationships of these driving forces and how they combine to effect the environment.

Population growth

The global population doubled between 1950 and 1987, from 2.5 billion to 5 billion. Reaching the first 2.5 billion took the human species from its beginnings up to 1950; the second 2.5 billion took less than 40 years. United Nations' estimates place the world population at 8.5 billion by 2025 and 10 billion by 2100.



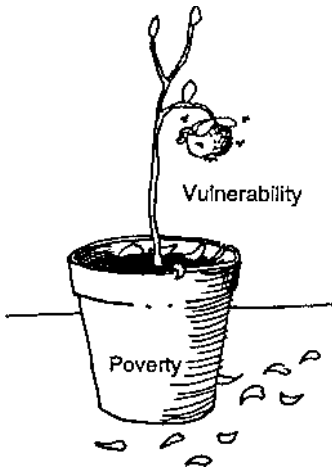
LEARNING OBJECTIVES

Brazil's Atlantic forest, which once covered a million square kilometers, is now only 7% of its original size.

Figure 5
Population growth, 1750-2100

Source: Thomas Merick, et.al., "World Population in Translation" *Population Bulletin*, Vol. 42, No. 2 (1986).

An estimated 60% of the developing world's poor live in areas vulnerable to environmental change, such as hillsides and tropical forests



Each person in the world demands from the environment food, water, clothing, and shelter – among other needs. Logically, the more people, the greater the demand will be on the environment. Each person in a developing country; however, this apparent disparity is somewhat altered by the prediction that 95% of future population growth will occur in developing countries, where resources are already strained.

Poverty

The world's poor are increasing in number at a more rapid rate than the general population and are the most vulnerable because of the substandard buildings and sites that they inhabit. As do the rest of the world's inhabitants, the poor depend on the environment and are often forced to degrade it to survive. Due to rapid population growth, the modernization of agriculture and unequal land tenure, increasing numbers of people have little or no access to productive land and are pushed to marginal areas. An estimated 60% of the developing world's poor live in areas vulnerable to environmental change, such as hillsides and tropical forests (World Resources Institute.)

The desperation induced by poverty prevents the consideration of sustainable environmental practices, and the cycle of poverty intensifies as the land loses its productivity and biological resources. The poor also tend to have more children – to increase the family labor force and provide security for old age.

Economic growth

Economic growth historically has affected the state of the environment but, for the first time in human history, human economic activity is so extensive that the global environment is changing. Future environmental outcomes depend on the way societies choose to use resources – such as the types of industries promoted, the amount of land used for agriculture, the amount and types of energy consumed, the way industrial and human wastes are managed. These choices are intricately connected with economic and political structures, social values and norms. Economic growth, however, is clearly necessary to improve standards of living for the poor and give everyone access to education, health care and employment.

Increasing urbanization

A significant percentage of the gross domestic product (GDP) of many countries is generated in urban areas. As conditions become less favorable for agricultural production, and as populations increase, people from rural areas move to cities to find job opportunities and services. The world's urban population will grow significantly in the future. Today, one quarter of all city dwellers now live below the poverty line; this proportion is also expected to increase.

Cities impose tremendous pressures on environmental resources, particularly air and water. Traffic congestion in Cairo and Mexico City causes serious air pollution. Karachi and Bombay experience chronic water shortages. In developing countries, improvement of the infrastructure cannot keep pace with growth, a situation that limits productivity and results in

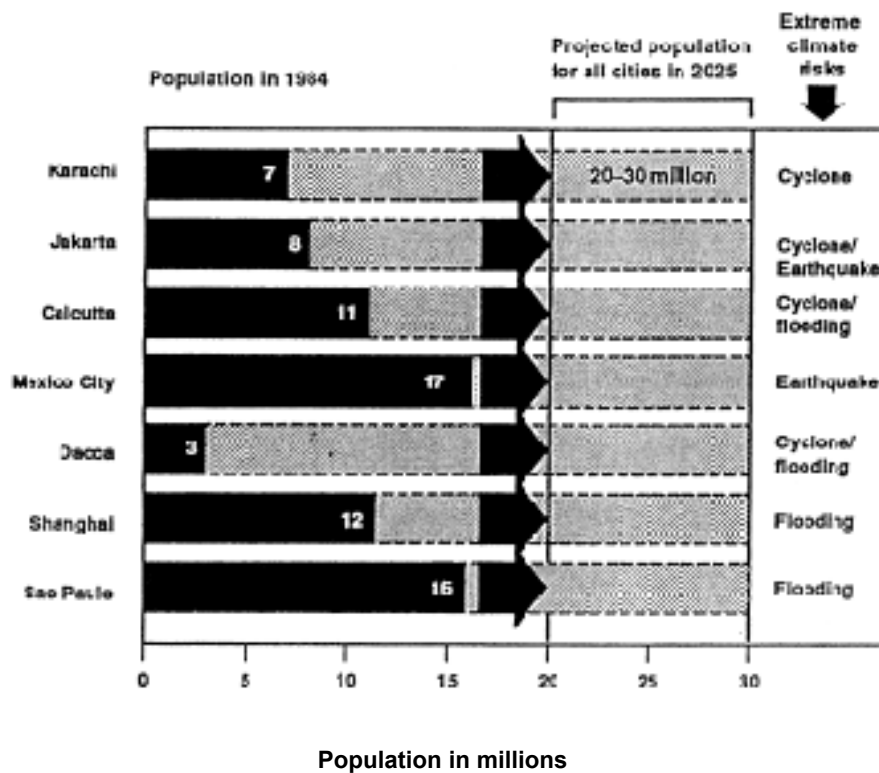


Figure 6
Population projections for some disaster-prone cities.

extensive urban poverty. Cities are expanding rapidly into peripheral areas, claiming agricultural lands but also becoming more densely populated. The density of buildings and people increase the risks associated with disasters.

Technological change

The types of technology that societies use will ultimately determine how the environment will be impacted. In many industrialized countries technologies that control emissions have significantly improved the air and water in urban areas. As developing countries grow, the types of technologies chosen will influence the amounts of energy consumed and pollution generated.

Political-economic institutions

Markets, governments, and international political economies affect the environment, as do policies and economic structure at the national level. Unequal access to land and other natural resources, to education, financial credit, social services and political rights worsen poverty and create barriers to development.

Conversely, incentives can be provided for environmental protection. The economic choices made by governments can indirectly or directly lead to either environmental preservation or degradation. These include the percentages of national budgets allocated to development needs and the latitude given to economic ventures to earn foreign currency.

Attitudes and beliefs

Beliefs and values, as they relate to material possessions, are frequently the root cause of environmental degradation, often having the greatest effects over generations of human lives. These attitudes and beliefs may have more influence over individual use of resources in some areas than social or economic variables.

Q. *What are the major driving forces that influence human interaction with the environment? In terms of your own country, discuss the negative and positive effects of each of these driving forces. Discuss the relationships between economic growth, the urbanization trend and the expected increase in the percentage of urban poor.*

A. _____



The effect of hazards on the environment and factors contributing to vulnerability

A hazard is an extreme event in a natural or human-made environment that adversely affects human life, property or activity to the extent of causing a disaster. Whether or not a hazard becomes a disaster, or a major disruptive events, depends on the extent of the hazard and the degree of vulnerability of the local communities, structures, services or geographic areas. In the charts given below, the causal phenomena, typical adverse affects and factors contributing to vulnerability are listed for 13 major hazards. This is by no means an exhaustive list of hazards and similar charts could apply to others such as snow storms, fires, wind storms, species extinction, and war and civil conflict.

EXERCISE

For each of the hazards that follow, list the driving force(s) that underlie each “factor contributing to vulnerability”. These may be considered the root causes which lead to the conditions listed.

Causal phenomena

Slippage of crustal rock along a fault or area of strain and rebound to new alignment.

Typical adverse effect

Physical damage – Damage or loss of structures or infrastructure.

Fires, dam failures, landslides, flooding may occur.

Casualties – Often high, particularly near epicenter or in highly populated areas or where buildings not resistant.

Public health – Fracture injuries most widespread problem. Secondary threats due to flooding, contaminated water supply, or breakdown in sanitary conditions.

Water supply – Severe problems likely due to damage of water systems, pollution of open wells and changes in water table.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Location of settlement in seismic areas.
- _____ Structures which are not resistant to ground motion.
- _____ Dense collections of buildings with high occupancy
- _____ Lack of access to information about earthquake risks

Causal phenomena

Fault movement on sea floor, accompanied by an earthquake

A landslide occurring underwater or above the sea, then plunging into the water.

Volcanic activity either underwater or near the shore.

Typical adverse effects

Physical damage – The force of water can raze everything in its path but the majority of damage to structure and infrastructure results from flooding.

Withdrawal of the wave from shore scours out sediment and can collapse ports and buildings and batter boats.

Casualties and public health – Deaths occur principally by drowning and injuries from battering by debris.

Water supply – Contamination by salt water and debris or sewage may make clean drinking water unavailable.

Crops and food supplies – Harvests, food stocks, livestock, farm implements and fishing boats may be lost. Land may be rendered infertile due to salt water incursion.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Location of settlements in low lying coastal regions
- _____ Lack of tsunami resistant buildings
- _____ Lack of timely warning systems and evacuation plans
- _____ Unawareness of public to destructive forces of tsunamis



Earthquakes



Tsunamis

ANSWER (page 26)

Population growth, poverty, economic growth, urbanization, technological change, political-economic institutions, and attitudes and beliefs.



Volcanic eruptions

Causal phenomena

Magma pushed upward through volcanic vent by pressure and effervescence of dissolved gases.

Typical adverse effects

Casualties and health – Death from pyroclastic flows, mud flows and possibly lava flows and toxic gases. Injuries from falling rock, burns; respiratory difficulties from gas and ash.

Settlement, infrastructure and agriculture – Complete destruction of everything in the path of pyroclastic, mud or lava flows; collapse of structures under weight of wet ash, flooding, blockage of roads or communication systems

Crops and food supplies – Destruction of crops in path of flows, ash may break tree branches, livestock may inhale toxic gas or ash; grazing land may be contaminated.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- | | |
|-------|--|
| _____ | Settlements on the flanks of volcanoes |
| _____ | Settlements in the historical paths of mud or lava flows |
| _____ | Structures with roof designs not resistant to ash accumulation |
| _____ | Presence of combustible materials |
| _____ | Lack of evacuation plan or warning systems. |
-

Causal phenomena

Downslope transport of soil and rock resulting from naturally occurring vibrations, changes in direct water content, removal of lateral support, loading with weight, and weathering, or human manipulation of water courses and slope composition.

Typical adverse effects

Physical damage – Anything on top of or in path of landslide will suffer damage. Rubble may block roads. Lines of communication or waterways. Indirect effects may include loss of productivity of agricultural or forest land, flooding, reduced property values.

Casualties – Fatalities have occurred due to slope failure. Catastrophic debris slides or mudflows have killed many thousands.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- | | |
|-------|---|
| _____ | Settlements built on steep slopes, softer soils, cliff tops |
| _____ | Settlements built at the base of steep slopes, on mouths of streams from mountain valleys |
| _____ | Roads, communication lines in mountain areas |
| _____ | Buildings with weak foundations |
| _____ | Buried pipelines, brittle pipes |
| _____ | Lack of understanding of landslide hazard |



Landslides

Causal phenomena

Mixture of heat and moisture forms a low pressure center over oceans in tropical latitudes where water temperatures are over 26 degrees C.

Wind currents spin and organize around deepening low pressure over accelerating toward the center and moving along track pushed by trade winds

Depression becomes a tropical cyclone when winds reach gale force or 117 km per hour

Typical adverse effects

Physical damage – Structures lost and damaged by wind force, flooding, storm surge and landslides.

Casualties an public health – May be caused by flying debris, or flooding. Contamination of water supplies may lead to viral outbreaks and malaria.

Water supplies – Ground water may be contaminated by flood waters.

Crops and flood supplies - High winds and rains can ruin standing crops, tree plantations and food stocks.

Communications and logistics – Severe disruption is possible as wind brings down telephone lines, antennas and satellite disks. Transport may be curtailed.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Settlement located in low lying coastal area (direct impact)
- _____ Settlement in adjacent areas (heavy rains, floods)
- _____ Poor communications or warning systems
- _____ Lightweight structures, older construction, poor quality masonry
- _____ Infrastructural elements, fishing boats and maritime industries

Causal phenomena

Naturally occurring flash, river and coastal flooding from intense rainfall or inundation associated with seasonal weather patterns

Human manipulation of watersheds, drainage basins and floodplains

Typical adverse effects

Physical damage – Structures damaged by washing away, becoming inundated, collapsing, impact of floating debris. Landslides from saturated soils. Damage greater in valleys than open areas.

Casualties and public health – Deaths from drowning but few serious injuries. Possible outbreaks of malaria, diarrhea and viral infections.

Water supplies – Contamination of wells and groundwater possible. Clean water may be unavailable.

Groups and food supplies – Harvests and food stocks may be lost to inundation. Animals, farm tools and seeds might be lost.



Tropical cyclones



Floods



Floods



Droughts

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Location of settlements on floodplains
- _____ Lack of awareness of flooding hazard
- _____ Reduction of absorptive capacity of land (erosion, concrete)
- _____ Non-resistant buildings and foundations
- _____ High risk infrastructural elements
- _____ Unprotected food stocks, livestock and standing crops
- _____ Fishing boats and maritime industries

Causal phenomena

Immediate cause – Rainfall deficit

Possible underlying causes – El Nino (incurion of warm surface waters into the normally colder waters of South American Pacific); human induced changes in ground surface and soil; higher sea surface temperatures; increase of atmospheric carbon dioxide and greenhouse gases.

Typical adverse effects

Reduced income for farmers; reduction of spending from agricultural sector; increase in price of staple foods, increased inflation rates, deterioration of nutritional status, famine, illness, death, reduction of drinking water sources, migration, breakup of communities, loss of livestock.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Location in an arid area where dry conditions are increased by drought
- _____ Farming on marginal lands, subsistence farming
- _____ Lack of agricultural inputs to improve yields
- _____ Lack of seed reserves
- _____ Areas dependent on other weather systems for water resources
- _____ Areas of low soil moisture retention
- _____ Lack of recognition and allocation of resources to drought hazard

Causal phenomena

Air pollution – pollutants such as sulphur dioxide, nitrogen oxides, particulates, carbon monoxide, and lead from industry and transport.

Marine pollution – Sewage, industrial effluents, marine litter, petroleum spills and slumped radioactive substances.

Fresh water pollution – Discharge of human waste and domestic wastewaters into lakes and rivers, industrial effluents, use of irrigation and pesticides, runoff of nitrogen from fertilizers. Increased runoff from deforestation causing sedimentation.

Possible global warming – Accumulation of Carbon dioxide from combustion of fossil fuels, deforestation, and methane from livestock.

Ozone depletion – Chlorofluorocarbons (CFCs) released into the atmosphere deplete ozone shield against ultraviolet light.

Typical adverse effects

Air pollution - Damages agricultural crops, forests, aquatic systems, structural materials and human health.

Water pollution – Spread of pathogens, injury to marine animals, spread of chemicals to the environment effecting the health of humans, animals and sea life.

Global warming – Sea level rise, climate change, temperature rise.

Ozone depletion – Increase in skin cancer, cataracts, reduction in immune system functions, damage to marine life.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ High levels of industrialization and per capita consumption
- _____ Lack of regulation of pollutants
- _____ Insufficient resources to counter the impact of pollution

Causal phenomena

The spread of farming and grazing

Firewood collection

Timber harvesting

Typical adverse effects

Deforestation results in loss of free products from the forest such as fruits and medicines, and decline in traditional cultures. It stresses economies which import forest products and are dependent on wood products. It contributes of other hazards, such as:

Flooding – Deforestation of watersheds can increase severity of flooding, reduce streamflows, dry up springs in dry season and increase sediment entering waterways.

Drought – Removal of roots and leaf canopy can alter moisture levels drying soil and decreasing precipitation.

Famine – Decrease in agricultural production due to erosion of topsoil and collapse of hillsides may lead to food shortages.

Desertification – Deforestation and removal of vegetation lead to soil compaction and reduction of land productivity.

Environmental pollution – Increases contamination of soil and water and reduces carbon dioxide absorption capacity. Burning of forests and decay of trees releases carbon dioxide to the air, possibly contributing to global warming.



Environmental pollution



Deforestation



Deforestation

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Underdevelopment
 - _____ Dependence on wood for fuel and income
 - _____ Unregulated logging and land clearance
 - _____ Rapid population growth
 - _____ Rapid expansion of settled or industrialized areas
-

Causal phenomena

Basic conducive climatic conditions such as low or uncertain rainfall and higher temperatures as found in dryland areas.

Poor land use management practices particularly overcultivation, overgrazing, deforestation and poor irrigation practices.

Typical adverse effects

Desertification contributes to other hazards by reducing the productivity of the land. These include drought and famine. Reduced productivity has socioeconomic impacts and may reduce standards of living.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Low rainfall and high temperatures
 - _____ Heavy land use
 - _____ Deforested areas
 - _____ Poor irrigation management
 - _____ Lack of conservation measures
 - _____ Lack of appropriate agricultural technologies
-

Causal phenomena

Increase in pest numbers due to one or a combination of ecological factors including temperature, monoculture of crops, introduction of plants to new location, introduction of pest species, overcoming genetic resistance in host, overcoming pesticide effects, conducive weather patterns, migration.

Typical adverse effects

Crop losses could lead to food shortages, even famine, and stress economic systems.



Desertification



Pest infestation

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Large numbers and varieties of pests
- _____ Lack of controls on imported plant products
- _____ Constraints on resources to predict and treat pest infestations
- _____ Insufficient crop yields in normal times
- _____ Areas inaccessible to surveillance for pests
- _____ Underdevelopment of agricultural technologies

Definition: Exposure to a toxin resulting in pronounced rise in number of cases of parasitic or infectious origin.

Causal phenomena

- Unsanitary conditions, crowding, poverty
- Ecological changes that favor breeding of vector
- Non-immune persons migrate to endemic disease area
- Decline in nutritional status
- Contamination of water or food supply

Typical adverse effects

- Illness and death
- Social and political disruption, economic loss
- Increased trauma in emergency settlements

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- _____ Lack of immunity (or vaccination) to diseases
- _____ Poor nutrition, poor sanitation, poor water quality, crowding
- _____ Poorly organized health care delivery
- _____ Drug resistant diseases



Pest infestations



Epidemics



Chemical and industrial accidents

Causal phenomena

- Disaster/explosion in a plant or storage facilities handling toxic substances
 - Accidents during the transportation of chemicals
 - Contamination of food or the environment by misuse of chemicals
 - Improper waste management of toxic chemicals
 - Technological system failures
 - Failures of plant safety design or components.
 - Natural hazards such as fire, earthquake or landslides
 - Arson or sabotage
-

Typical adverse effects

Physical damage—Damage or destruction may occur to structures and infrastructure. Transportation accidents damage vehicles and other objects on impact. Industrial fires may reach high temperatures and affect large areas.

Casualties—Many people may be killed or injured and require medical treatment.

Environmental—Contamination of air, water supply, land, and animal life may occur. Areas may become uninhabitable for humans and animals. Ecological systems may be disrupted even on a global scale.

Factors contributing to vulnerability

LIST DRIVING FORCE(S) THAT RESULT IN THE FOLLOWING CONDITIONS:

- | | |
|--|---|
| | Populations living in proximity to potential accident sites |
| | Lack of safety features or lack of evacuation plan. |
| | Unawareness by vulnerable persons of the potential danger. |

Environmental degradation – more and bigger disasters

An examination of the interactions of the earth’s systems reveals a fine mesh of interrelationships – changes in one system will eventually affect another. The following flow charts, although they simplify the relationships, indicate the domino effect of environmental degradation.

***E*XERCISE**

After studying the flowcharts shown in Figures 7,8 and 9, make up your own chart on a separate piece of paper using poverty as the theme. It should encompass nearly all of the flow charts shown here.

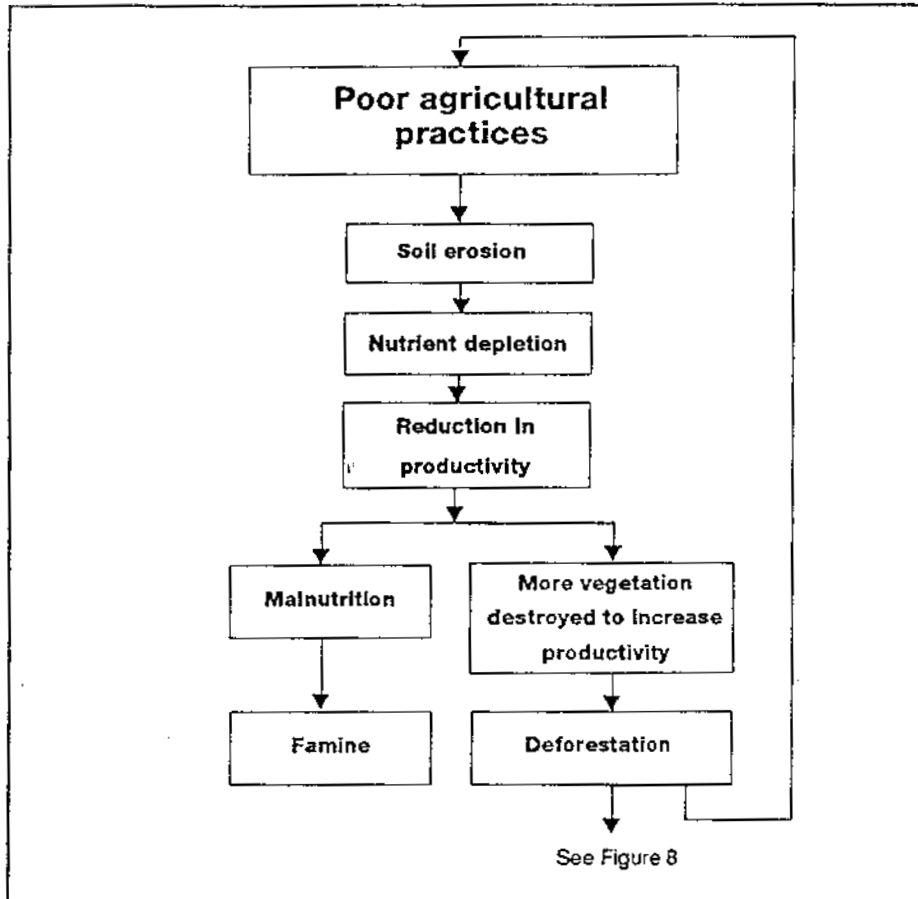


Figure 7
Poor agricultural practices flowchart

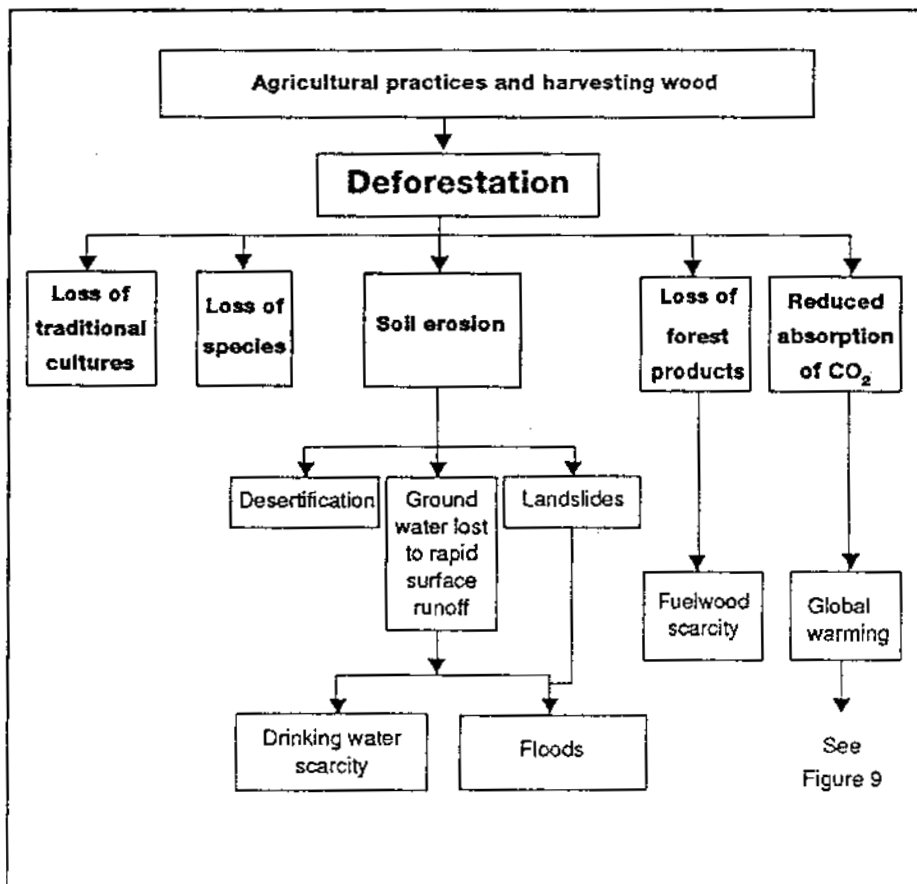


Figure 8
Deforestation flowchart

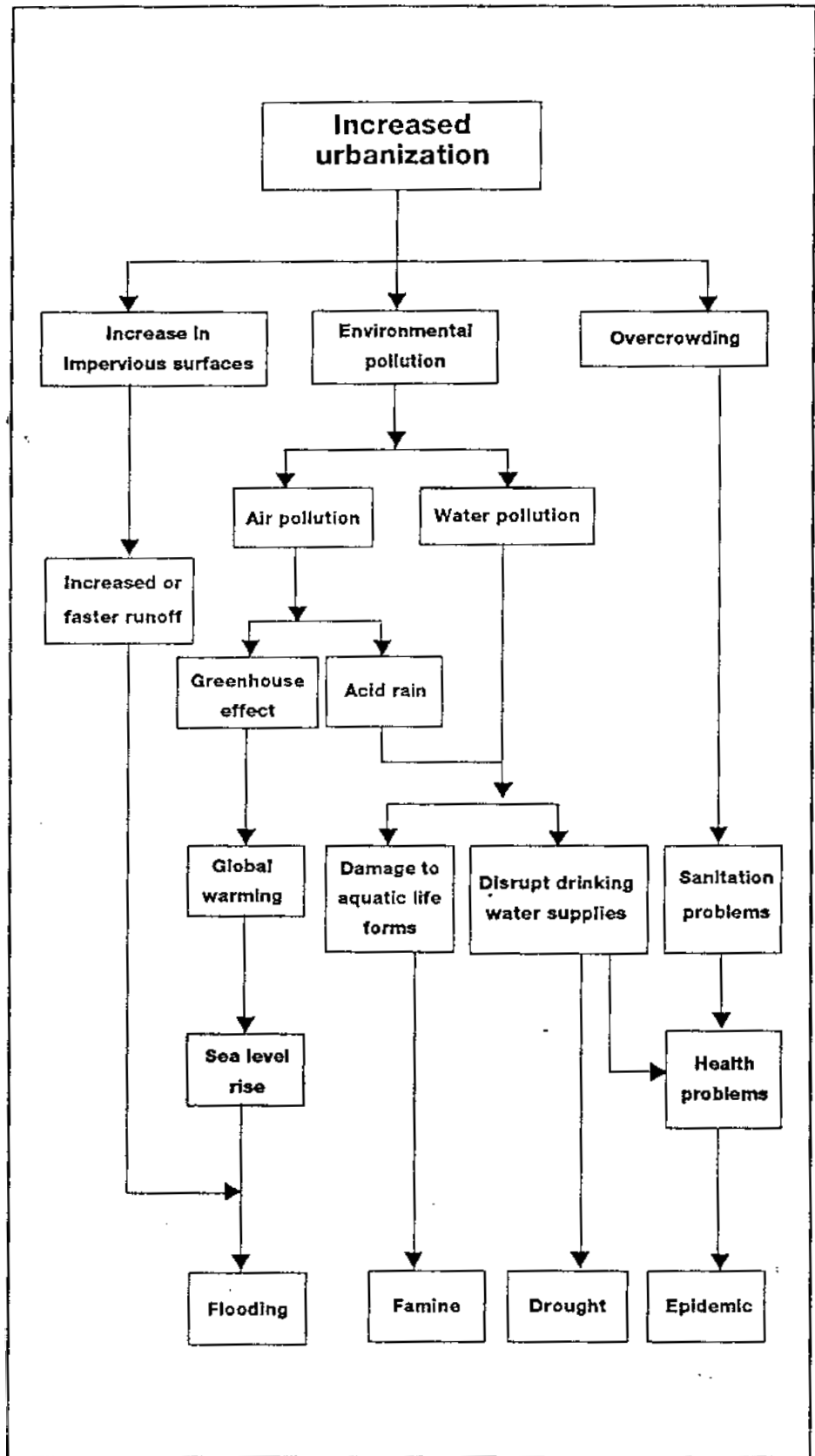


Figure 9
Increased urbanization
flowchart

MITIGATING ENVIRONMENTAL DEGRADATION

This part of the module:

- *Discusses the concept of sustainable development*
- *Identifies the goals of environmental management.*
- *Describes the interrelationship between disaster mitigation, environmental management and sustainable development.*

A response to the problem

In part one, we focused on the interaction of the earth's systems and how degradation of the systems are interrelated. In part two, the root causes of degradation are examined and their role in increasing vulnerability to hazards and disasters. In this part, we focus on our goals to maximize our social well being and to prevent potential problems by addressing their root causes. We then must view environmental issues in the context of development. On the other hand, overcoming many root causes such as poverty will require long term efforts and in the meantime, valued resources may be lost and disasters will occur. Thus we must also focus on activities to manage the environment while mitigating disaster.

What can we do to prevent environmental degradation and change from harming our environment(s) while acknowledging that environmental resources are necessary for development? Interventions that respond to or anticipate environmental change at any point are called mitigation measures. Through mitigation, we may prevent, limit, or slow the rate of damage or change. Taking mitigation measures makes sense; the pains required to prevent disasters are much less than the consequences we suffer if disasters do occur.

Environmental management overlaps with disaster management in the area of development – both employ mitigation to prevent environmental degradation. Environmental management also seeks to efficiently use resources for development and to conserve them, recognizing that lost resources, such as traditional cultures, species of plants and animals, and arable land, cannot be restored. Mitigation measures usually provide an excellent return on development investment. One example would be the introduction of energy efficient stoves: while use of such stoves decreases deforestation, it also reduces the labor and expense of producing fuel.

LEARNING OBJECTIVES

Taking mitigation measures makes sense: the pains required to prevent disasters are much less than the consequences we suffer if disasters do occur.

S. Reed



The concept of sustainable development

Following the United Nations Conference on the Human Environment in 1972, an environmental movement emerged in both industrialized and developing countries, changing attitudes from simply mitigating the destruction of natural resources to integration of environmental concerns with economic growth and development. The problems associated with affluence and poverty are sometimes different, but the developing nations must promote economic activities to improve national living standards. In 1987, the concept of sustainable development received international attention through its endorsement in the report by the World Commission on Environment and Development (WCED). The implementation of sustainable development has become an important challenge of the 1990s.

The United Nations Conference on Environment and Development was held in Brazil in June of 1992 where more than 100 world leaders met for a round table summit and 17,000 attended a global forum on sustainable development. At this “Earth Summit,” world leaders endorsed *Agenda 21*, the action plan to promote a global transition to sustainable development and the *Rio Declaration on Environment and Development*, a set of 27 principles to help govern economic and environmental behavior.

WCED has defined *sustainable development* as development that meets the needs of the present without limiting the potential to meet the needs of future generations. There are two major concepts:

- the awareness of needs, in particular, giving overriding priority to the needs of the world’s poor,
- the realization that meeting needs are limited by the state of technology and social organizations.

The dimensions of sustainable development are described below. However, as yet, the actual mechanisms needed to achieve sustainability are subject to uncertainty. For example, economic benefits may be difficult to ascertain as there are no methods to quantify some environmental costs. Nevertheless, no economic venture can be considered profitable if it depletes resources, passing on the costs to future societies. The concept of sustainable development offers a basis for program design and a goal worthy of attainment. Progress toward sustainable development will only be achieved through international cooperation, political will, and improved policies. The following are general policy directions that may be adapted for specific countries and situations.

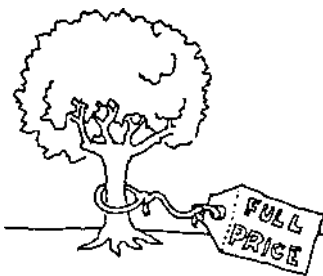
Economic policies

Proper resource pricing – Undervalued resources are often wasted. For example, the fact that clean air has no price may encourage pollution. The European Community now proposes levying energy taxes based on the carbon content of fuel to control carbon dioxide emissions. Forest resources are typically undervalued, leading to an exploitation of timber that has little development benefit. Realistic pricing that recognizes the value of non-timber forest products, along with conservation practices, would promote sustainable development.

SUSTAINABLE DEVELOPMENT



Undervalued resources are often wasted. For example, the fact that clean air has no price may encourage pollution.



Land reform – Many poor people in developing countries do not own the land they farm; however, when people have secure rights to land and trees, they invest in and conserve these resources. Although politically difficult to implement, land reform policies may be an important stimulus to development. Other policies which facilitate land reform include: increases in land taxes; elimination of credit subsidies, especially to livestock operations; control over inflation and investment in new knowledge or technologies.

Human-oriented policies

Rural and agricultural development – Many development programs have neglected the poorest segments of the population; true sustainable policies should commit public funds to providing basic services for everyone. Favoring urban over rural development is neither practical nor sustainable. Rural and agricultural development is essential for a society's general economic development; it prevents further degradation of such natural resources as soils and forests.

Human development – Evidence from the performance of rapidly growing economies indicates that investment in human development is one of the most effective strategies. This includes providing more and better education, health care, and social services. When the responsibility for planning and executing development programs is moved from centralized agencies (which often lack the information and resources to manage small activities) to community-based operations, then local talent becomes involved and the disadvantaged benefit.

A wide range of policies can support human development, such as community-based maternal/child, health/nutrition, and family planning programs. Urban self-help programs have improved urban conditions, while small credit programs have reduced poverty by providing seedlings, credit and land to peasants.

■ *Case Study*

Working against drought and disease in Tunisia

Water has long been a scarce commodity in Tunisia, particularly in the south; recent droughts have dried up many small reservoirs and lowered the groundwater levels, causing many wells to be abandoned. Many wells still in use contain dangerous salt levels and agents of such diseases as viral hepatitis, typhoid, and other strains of diarrhea. The local Ministry of Health has determined that latrines and septic tanks situated above or at the same level as the water table contributed to the contamination.

In 1984, following a dramatic increase in incidences of waterborne diseases, Tunisia focused its efforts on improving water quality. Since that time, dramatic improvements have taken place. While only 20% of the rural population has adequate sanitary facilities, the percentage having a safe supply of water has risen from 15% to 50%. With the help of donors, many village wells were rehabilitated. Village water committees were set up nationwide, to support caretakers for the pumps and assure that the pumps remained repaired.




Tunisian women at village tap
Source, March 1990.

The greatest improvement has been in people’s health. The incidence of viral hepatitis was cut to 0.1% from a previous level of 50%; the incidence of diarrhea has been reduced by 80%. A focus on health education is responsible for much of this improvement. Children, even in remote villages, can recite the steps to clean water and improved sanitation (“Add three drops of chlorine to one liter of water”, “Wash your hands before every meal”). Until recently, people were using polluted sources of water because they did not understand the hazards.

Q. How is the Tunisia water and sanitation project reducing vulnerability to disasters? How is it preventing environmental degradation? How is it sustainable?

A. _____



International and national policies in forestry, fisheries and wildlife management must also provide economic incentives and laws to protect biodiversity

Environmental policies

International agreements – for reducing the use of fossil fuels as energy sources – are essential for stabilizing global climate. The *Earth Summit Convention on Climate Change* and the *principles for Management of All Types of Forests* provides guidelines for reducing and stopping deforestation and for technological cooperation to produce resource-efficient, low-polluting technologies for developing countries.

Soil erosion and degradation can only be stopped if farmers and agribusiness invest in soil conservation. However, some subsidies in developing countries discourage sustainable agricultural practices. For example, subsidies for certain agricultural chemicals encourage the use of monoculture, which depletes the soil. In developed countries – such as Japan and the United States as well as in Europe – subsidies for fertilizers and pesticides result in high usage of these chemicals on farms; the subsequent runoff of chemicals into streams and rivers is also high, making agriculture one of the largest polluting activities.

One key goal of sustainable development – using biological resources while protecting the biodiversity of species – requires greater efforts to preserve natural habitats and ecosystems. International and national policies in forestry, fisheries and wildlife management must also provide economic incentives and laws to protect **biodiversity**. Biodiversity may be defined as an umbrella term for the degree of natural variety including diversity of genetic material, species, ecosystems and human cultures.

BIODIVERSITY



The need for improvement in institutional and professional skills is particularly acute in developing countries. Community involvement and education is essential – the field of biotechnology is making genetic resources increasingly valuable. Countries may choose to declare sovereignty over their resources and regulate any collecting of such resources by outsiders by following guidelines established at the Earth summit Convention on Biological Diversity.

Sustainable systems through technology

Incentives must be established to reduce pollution and wastes. Economic incentives may be introduced that increase the demand for energy- and resource-efficient technologies, to ease the stresses on forests and to stop water and air pollution.

Public opinion may also exert pressure for the support of more environmentally sound technologies. In the United States, laws requiring disclosure of toxic waste releases helped pressure industries to reduce emissions, while in eastern Europe, lack of such public disclosure in some cases allowed pollution levels to grow to dangerous levels without opposition. The “polluter pays” principle, using environmental charges and taxes, may help reflect actual environmental costs in market prices.

The search continues for answers to this key question: Which policies will promote the use of cleaner, more efficient technologies? If all countries demand such technologies, such demand may stimulate research and reveal new opportunities for adopting innovative policies.

■ CASE STUDY

Flood disaster prevention in Taiz, Yemen

Taiz, as the second largest city in the Yemen Arab Republic, is victim to many of the problems resulting from rapid urban growth. The population of 150,000 has more than doubled in the past five years. About 28% of the homes are flooded every year – 32% are flooded every ten years. In 1982, an unusually severe flood occurred after three days of rain, causing widespread damage.

The effects of the floods on the urban environment are moderate but may happen five to ten times per year. Sediment accumulates at major traffic intersections, disrupting traffic; streets erode and underground utilities are exposed to pedestrian traffic. The floods more often affect the homes and businesses of the poor. The annual direct loss from floods is about US\$27 million. This estimate does not consider the production loss caused by damage to infrastructure.

The following factors have rendered the Taiz area vulnerable to flooding as well as to other disasters. First, environmental degradation has progressed rapidly, due mainly to the unplanned expansion of human settlements. Secondly, infrastructure and services are poorly maintained and inadequate to cope with an increasing demand. And third, the managerial and financial capabilities of regulatory and policy agencies in Yemen are weak; thus programs are often poorly planned and implemented.

The “polluter pays” principle, using environmental charges and taxes, may help reflect actual environmental costs in market prices

ANSWER (from page 40)

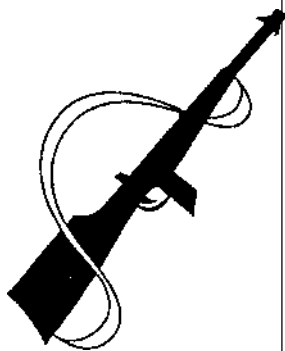
It reduces vulnerability to epidemics. It prevents degradation of water supplies, increases water availability and upgrades the urban environment. It is sustainable, since 1) It provides health education that Tunisians, especially their children, will use to maintain sanitation throughout their lifetimes; 2) It also provides for the establishment of the water committees in the villages.

In 1988, the International Development Association (IDA) conducted a study that prioritized flood control over other improvements, to safeguard development efforts. A project was designed in coordination with the Ministry of Municipalities and Housing (MMH) of Yemen to improve Yemen’s physical infrastructure while strengthening the local institutions. The project was designed to provide:

- Flood control structures to protect the most vulnerable parts of the city, such as open channels, culverts, and sediment and boulder traps.
- The restoration of street pavement, terracing of both unstable slopes and surface drainage footpaths in narrow streets, to control erosion.
- The purchase of equipment to maintain roads and flood control works.
- Technical assistance for strengthening the MMH and its branch offices.
- Technical assistance for the management of construction projects.
- The introduction of a new municipal resource mobilization policy to make maximum use of existing resources.
- The preparation of a future urban development project and staff training.

Q. What requirements of sustainable development does this project fulfill?

A. _____

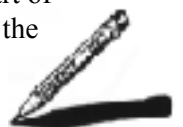


A crucial part of sustainable development is the reversal of these spending priorities and the reduction of military conflicts.

A global human issue: the effects of war on development and the environment

War and its aftermath are a continuing threat to sustainable development. The 1991 Persian Gulf War brought widespread damage to the region’s air, water, land, vegetation, animal life and human inhabitants. War, or armed conflict, is a disaster which demonstrates that environmental destruction can be rapid and deliberate, rather than building gradually, as most other human-made hazards do. Wars make hazards-mitigation measures and development very difficult or impossible and significantly affect economic performance.

Preparations for war consume a large part of the national budgets of both developing and industrialized nations, deflecting those funds from development efforts. War often drives the poor – desperate for food and income – to inflict further degradation on the environment. A crucial part of sustainable development is the reversal of these spending priorities and the reduction of military conflicts.



Environmental management

Environmental management addresses environmental issues together with the process of sustainable development. Appropriate management is achieved when resources are used efficiently or conserved because of their important ecological role in sustaining ecosystems. Inappropriate management occurs when resources are overused or underutilized, or when resources forming the basis for local and global ecosystems are not conserved.

Inherent within the environmental management perspective is the concept of “environmental opportunity”. These opportunities can include both the exploitation and conservation of a resource, or whatever will maximize sustainable progress. In some cases, the maximum benefit from a resource might be obtained only by leaving it alone. These are a few examples of environmental opportunities:

- Development of solar energy and biomass fuels.
- Protecting biodiversity to maintain the world’s ecological balance.
- Managing the tropical rain forests.
- Use of formal and non-formal education sectors to promote environmental awareness and create an environmental culture.

An important facet of environmental management is the formation of national environmental policies and legislation which relates to and supports national socioeconomic goals. National goals, however, are often based on pressures to increase production and may lead to destructive use of resources. Adoption of the concept of sustainable development can be encouraged through persuasion by consumers, legal regulation, and economic incentives.

Environmental management relies heavily on institutional and community participation in the process. For example, the presence and assistance of national environmental institutions allow environmental management programs to succeed, therefore it is important that these institutions are developed. Planning and management has to be decentralized to the community level where people have a better knowledge of their local environment and so that their interests are considered.

REVIEW

Q. Why are disaster mitigation and environmental management essential components of sustainable development?

A. _____


ANSWER (from page 42)

It fulfills some aspects of each major area. (economic: resource mobilization; human-oriented policies: training; environmental policies: urban development plan; and technological inputs)



Q. Name three components of environmental management.

A. _____

_____ 

Q. Give an example from your country where undervalued resources have been wasted or not conserved. Do development programs in your country always have a training component? For rural as well as urban professionals? Does your country have an environmental protection plan? How does it address global environmental changes? What economic incentives are offered by your government to prevent environmental degradation? Are they effective? What others could be offered? What percentage of your country's budget goes to military spending? What percentage goes to environmental protection and human development?

A. _____

_____ 

ANSWER (from page 43)

Disasters can setback development, mitigation measures can contribute to development, environmental management has to be practiced for development to be sustainable and to prevent disasters.

ANSWER (from page 44)

Components of environmental management include environmental opportunity, support of national socioeconomic goals, and individual and institutional participation.

PART **4**

IMPLEMENTING ENVIRONMENTAL CHANGE

This part of the module focuses on:

- *The policies — both national and international — required to support or improve the environment in order to reduce vulnerability to disasters.*
- *Some practical suggestions for action.*

The implementation of environmental change to reduce the risk of disaster will be greatly enhanced by a comprehensive strategy. The activities of the strategy will need to be broad-based and multi-sectoral, and they should address the specific issues raised earlier in this module.

National policy and planning

National governments can best reduce the impact of disasters by collective action as part of a general environmental management effort. Policies for the public and private sectors must be geared to protect productive natural systems, as well as basic services and infrastructure.

Investing in human development

Because poverty is so intertwined with deteriorating environmental conditions and increased vulnerability to disasters, national programs must foster human development by providing basic services in:

Education – Investment in primary education provides twice as many economic returns as spending on higher education.

Health – Primary health care, when composed of community clinics providing preventative care and health education, may be ten times more cost effective in saving lives than curative care.

Population control – If all the women who say they want no more children had access to family planning services, the number of births would be sharply reduced.

LEARNING OBJECTIVES

National governments can best reduce the impact of disasters by collective action as part of a general environmental management effort.

Large-scale policies should encourage and support local, small-scale development.

Encouraging economic development

The debts of many developing nations in 1988 were larger than their incomes. The following points highlight suggestions for improving troubled national economies:

Structural adjustment¹ – Structural adjustment policies should be designed to minimize their adverse affects on the poor and to reduce future poverty, as well as contribute to natural resource management. Policy leverage, provided by adjustment programs, might be useful to support land reform, health education and other sustainable development priorities. Such policies, however, must be analyzed to ensure that environmental priorities are not compromised.

Local participation – Some of the most successful projects are those initiated and implemented by local communities and indigenous NGOs. One example is the provision of credit where participants have invested their own money.

Self-reliance – Large-scale policies should encourage and support local, small-scale development.

Employment opportunities – Agricultural prices should encourage agricultural production. This might be accomplished by decentralizing government programs to regional and local levels and by improving the investment climate through economic incentives and political stability.

Land tenure reform – In some countries, many farmers hold a tiny percentage of the land while others have very large holdings. These situations should be examined to determine if land is being used efficiently.

Removing subsidies – Removing the subsidies that users receive encourages more careful use of natural resources – such as fuel, water, land, even the air – by adjusting the costs of using those resources to higher, more realistic levels. More careful use of resources means conservation, which increases everyone's access to the resources.


Women's economic opportunities – Increases in women's status, education and earnings all are significant factors in improving a society's nutrition, health, and in reducing the size of its families.

In sub-Saharan Africa, women are responsible for 80% of agricultural production, 50% of animal husbandry, 90% of food processing and 60% of marketing. As women in many cultures are more directly involved with the environment in this way, it follows that environmental degradation affects them more directly than others. Development organizations must develop plans and activities that accurately reflect women's roles and needs.

¹ Structural adjustment is defined as an attempt to effect a major change in an economy. It aims to get the economy back to a healthy state, improving its balance of payments over the medium term, i.e., about 5 years. The main policy instruments used are incentives to increase production, saving, and investment in the public and private sectors, together with supporting monetary and budgetary policies.

Q. *Do you have a structural adjustment program in your country? What has its impact been on the poor? Are there ways that negative impacts could have been avoided? What effect does removing subsidies have on the conservation of resources? Give an example from your country.*

A. _____



Environmental protection

National planning – Addressing the root causes of environmental degradation, poverty and population growth will assist in conserving natural resources. Special efforts, however, must be directed to maintain as much as possible of natural ecosystems. A national environmental protection plan should include measures to:

- Restrict or regulate deforestation.
- Conserve biodiversity through various strategies such as maintaining protected areas.
- End fuel subsidies and seed alternative energy sources.
- Include communities in the design of projects and foster environmental awareness.
- Train local and government officials, who then train village-based officials in terracing, reforestation, water development, land management and other measures.
- Build the institutional capacity of environmental regulation and enforcement agencies.

Building on local technologies for agriculture and fuel – Research has shown that technologies already known and accepted have a higher rate of success than new and unfamiliar techniques. New technologies should build on traditional methods. Some environmentally advantageous strategies might include:

- **Raising agricultural potential with intercropping** (growing two or more complementary crops together), **agroforestry** (combining trees and crops), small-scale irrigation systems, organic recycling, and improved tilling (see “Improving agricultural practices” below for further discussion).
- Increasing energy supplies through the use of sun, wind, and water power, and by increasing biomass production, to buy time for the development of other renewable technologies – such as biogas. ²

² Biogas is defined as a mixture of gases, mostly methane, produced from decomposition of household wastes and organic matter in a special digester.

Figure 10
Cooperation required for disaster prevention through sustainable development planning



ANSWER (from page 47)

Removing subsidies:
Resources would be used more wisely and conserved. Those with higher incomes would have to pay more and thus may buy less. There would then be more available to others.

Mobilizing resources

Commitment by governments to reducing vulnerability should be made and resources allocated. Funds may have to be diverted from national budgets, along with some redirection of foreign assistance. By freezing their military expenditures at current levels, developing countries could free US\$10-15 billion per year. Further, education programs and incentives can help mobilize people to act on the local level.

Reducing the impact of disasters

Long-term efforts to prevent disasters through sustainable development planning should be a high priority for humanitarian and development assistance agencies. They should also incorporate efforts to reduce the vulnerability of infrastructure.

These measures will require cooperation between three basic groups: the agencies in charge of disaster preparedness and response; the agencies in charge of development; and the scientific and engineering research communities. These groups should plan for the following types of programs to be implemented on the regional, national and international levels:

Technical assistance – Country-overview documents should be prepared that cover all aspects of vulnerability to disasters. All agencies, technical documents and key professionals to be consulted should be identified in the country-overview documents.

Training – Technicians should be trained to prepare and update the country-overview documents. Professionals should be trained on an interdisciplinary basis, to assess vulnerability and patterns of environmental degradation as part of environmental planning. This includes river-basin planning; management of watershed areas; use of natural resources to meet the needs of the poor for food, fuel, safe building sites and building materials; assessment of landslide areas and assessment of desertification processes. Emphasis must be placed on food production, forest management and planned expansion of settlements.

Technology transfer – Techniques for managing information about hazards – including mapping, emergency preparedness and response information – must be made available to staff in charge of national planning. Information/technology on how to prevent human-made disasters, air pollution controls, trade in hazardous products, cleaner and safer production should also be provided.

Vulnerability reduction measures

The following is a representational list of strategies to protect the environment or support sustainable development. It is not an exhaustive list.

The atmosphere

Reducing air pollution – Most nations establish regulations to control air pollution locally by:

- Setting air quality standards by measuring pollutants at a distance from the source and requiring control for acceptable levels.
- Requiring every source of air pollution to meet certain emission limits, even if it requires developing new technologies to do so.

Slowing the rate of global warming – If theories regarding the effects of global warming should prove true, steps should be taken to prepare for those effects and certainly to prevent its acceleration. This would include measures to:

- Reduce the rate of deforestation by planting trees to meet community needs for wood (See “Reversing deforestation” below for more detail.)
- Increase the efficiency of energy production and use. Promote energy efficiency in urban areas and support renewable energy sources such as wind power, water power, geothermal and solar power. These may especially be of use where no traditional electricity sources exist
- Develop regulations to curb pollution from traffic emissions, industry, and urban areas

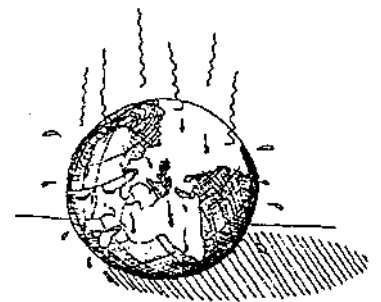
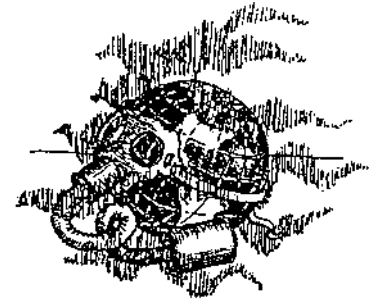
Halting ozone depletion – International cooperation is required to limit chlorofluorocarbon (CFC) emissions, reduce their production, and find substitutes. Developing countries can regulate the importation and use of aerosols, polystyrene and refrigeration units.

The Montreal Protocol is a multi-national agreement setting strict time limits for phasing out CFCs and other ozone-depleting substances, such as halons and carbon tetrachloride. Developing countries were given a 10-year grace period, and a fund of US\$240 million was created to compensate developing countries for added costs they may incur by following a CFC-free path. With these incentives, and in view of the seriousness of the global effects of ozone depletion, all countries should participate in this agreement.

The oceans

Controlling marine pollution – The coastal environment is particularly important in protecting the life in the sea. The following measures may help control ocean pollution:

- The coastal effects of inland activities should be considered in the planning stages, including land-use operations and manipulation of water cycles.
- Sewage disposal should be controlled.
- Public health standards regarding sewage pollution to beaches and shallow waters should be established and enforced; seafood sold for public consumption should be monitored.
- Regulations should be established regarding dumping of wastes into ocean waters.
- Prevent development in unstable coastal areas.



The water cycles

To reduce contamination of water by toxins and improve availability, the following measures may be taken:

- Soil improvement and tree plantings to help break down toxins and decrease water runoff.
- Watershed mapping, management, and protection.
- Sewage systems to dispose of human waste and domestic wastewater.
- Enforced regulations against toxic chemical dumping and excessive use of pesticides.
- Campaigns to prevent the wasting of water, especially in urban areas.
- Collection of rainwater using collection tanks, reservoirs and catchment basins.
- Recycling waste water for use in irrigation.

The land

Reversing deforestation – A multitude of methods exist for reforestation. Among these are:

- Large scale wood fuel plantations.
- Social or community forestry (where local people plant trees outside regular forested areas).
- Agroforestry (combining agriculture and forestry on the same plot).
- Trees planted as windbreaks.
- Silvopasture (integrating trees and livestock raising on the same plot).
- Tree crop plantations.
- Integrated land use (raising trees, crops, and livestock on one plot).

Strategies which prevent or control deforestation include:

- Management of natural woodlands to increase the production of forest products while renewing the resource.
- Promoting the design and use of improved wood stoves.
- Promote research on local forests to determine the usage patterns and the most sustainable ways to manage them.

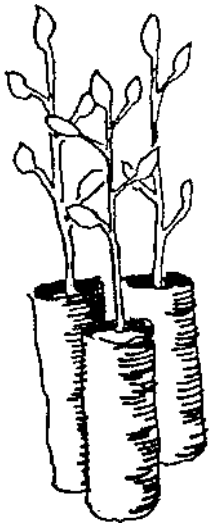
Reversing soil degradation – Moderate degradation of the soil may be improved by the following practices:

- Replenishing nutrients.
- Contour bunding (earth walls), terracing and tree planting to reduce erosion.
- Allowing land to lie fallow to regenerate.
- Stabilizing sand dunes with dryland plants.

Severe or extreme soil degradation is difficult or impossible to reverse.

■ **CASE STUDY**

The linkage between deforestation and disasters has been delineated in this module. This case study illustrates how the challenges produced by the threat of an environmental disaster have resulted in creative solutions to save the environment.



Using resources in order to save them: Can the Amazon pay its own way?

A more profitable harvest – Scientists studying the products of the rain forests near the Amazon have calculated that marketing the annual harvest from the existing vegetation, instead of clear-cutting the timber, would gross more in the long term than would selling the wood. On one farmer's small plot, perhaps one half hectare, near Iquitos, Peru, were found 842 trees belonging to 275 different species. Over the period of one year, the landowner could make almost \$700 from nine varieties of fruit, wild chocolate, rubber, and selected trees.

One clear-cut of timber would gross about \$1,000. However, through the cumulative value of sustainable harvests over 50 years, more than \$6,280 might be realized. The same amount of land in a nearby tree plantation was valued at \$3,184, where a comparable area in a cattle pasture was worth only \$2,960. Deforestation may be a poor investment.

Companies in developed countries have already started to use the harvest products. A chain of natural health and beauty stores in England offer a Brazil nut facial scrub. An ice cream manufacturer in the United States sells a popular "Rain Forest Crunch" flavor. Another plan to save the rain forest involves farming iguanas as an alternative to cattle, which currently occupy 85% of the cleared land in Amazonia. A pilot project is underway now; an iguana consumes 5% of the amount of food that a chicken or cow eats to produce the same quantity of meat, without destroying the forest. Iguanas are considered a delicacy in parts of Latin America.

A supermarket and pharmacy for the world – About one fourth of all prescription drugs were first derived from rain forest plants, discovered and used originally by the traditional cultures living there. The Malaysian natives use 2,500 plants for medicine, while natives in the Amazon use over 1,000. Quinine, the cure for malaria, was isolated from cinchona tree bark from Peru and has saved millions of lives. In Madagascar, local resident helped scientists to discover the rosy periwinkle, which when analyzed produced six compounds to fight cancerous tumors. The list of known medicinal plants is virtually endless, with perhaps many more still undiscovered.


People all over the world enjoy foods that were found in the rain forest and later domesticated. Coffee came from the Ethiopian rain forest, tea from southeast Asia, and many fruits and spices from other forests around the world. However, while domestic plants grown on plantations become susceptible to disease, the rain forest varieties have maintained resistance. Plant breeders have used genes from wild rain forest plants to save a number of important crops and thus stave off disaster for populations that depend on the crops.

As demands for lumber, meat and forest products from foreign sources increase – and governments agree to destroy the forests to earn money – the potential for discovering new medicines and foods decrease. Commitments from governments (including both buyers and sellers) is essential to conserve the forests.

In a pioneer effort, Costa Rica has recently contracted with a large international pharmaceutical company to conduct collaborative research with an indigenous biotechnology group founded by the government. The first step has been to collect and identify plants, insects and microbes, the products of which may be useful to humanity when reproduced synthetically. Part of this funding also goes to conserve biological diversity in the field.

Q. Should governments maintain sovereignty over the forest resources in their countries even if the benefits could serve human kind? How could governments negotiate this? Can you think of other ways to profit from the forests without destroying them?

A. _____

_____ 

The biosphere

Preventing loss of species and traditional cultures – Protection of habitat is essential for preventing extinction of species and loss of unique human cultures. Species protection involves policy reforms on the national level:



DODO

1. Reform existing policies that encourage the loss of biodiversity, including: unsustainable logging; short-term leases on public land; agricultural policies that encourage monocultures; and excessive use of pesticides, fertilizer and water.
2. Establish policies that promote conservation by:
 - Asserting sovereignty over genetic resources and regulation over their collection.
 - Regulate the introduction of non-native species.
 - Control water pollution.
 - Formulate practices for sustainable fisheries.
 - Set aside marine habitats when planning coastal development.
 - Respect the rights of local traditional societies.
3. Educate the public regarding the value of national genetic resource.

Controlling toxic chemical accumulation and preventing accidents —

The ready availability of toxic chemicals promotes their dispersal in the air, water, land, and living tissue. The following practices may help to reduce the amount of toxins in the environment:

- Industrial plants and storage facilities should be inspected for safety and any needed improvements made.
- Evacuation and warning procedures should be established in the event of an accident that might release large doses of toxins to the environment.
- Toxic waste disposal procedures should be monitored and toxic waste dumps documented on a “hazard map”, with information about chemicals dumped.
- Pollution levels of water air and souls should be monitored.
- Excessive use of household chemicals, pesticides and fertilizers should be discouraged.
- Better production methods should be adopted which produce fewer toxic substances.

Improving agricultural practices —The lives of a billion people would be improved by better nutrition. Some practices, including a combination of traditional techniques and modern methods, should help to restore land and improve yields:

1. *Intercropping* —The growing of two or more crops — with complementary needs for light, soil, or water — in the same field reduces the risk of single crop failure and can provide a regular supply of food all year. Yields may also increase. For example, when sorghum and groundnuts are intercropped, the combined yield is 25% higher than when grown separately. Millet and cowpea yields are more than 50% higher.
2. *Agroforestry* —Trees that are grown with food crops can fertilize the soil lower pest number, and provide extra moisture to the soil. This has significant potential, particularly for farmers who cannot afford fertilizers, pesticides, and irrigation.
3. *Small-scale irrigation* — Stone contouring — to hold back rainwater, force it to pool uphill and give it time to sink into the soil — has resulted in yield increases of up to 50%. Catching irrigation runoff from large plantations is another method.
4. *Organic recycling* — Use of crop residue and manure for fertilizer increases productivity. Alternative sources include sewage sludge and organic domestic wastes.
5. *Minimum tillage* — Since deep plowing can speed erosion and soil degradation, reducing the amount of tillage can improve soil conditions.
6. *Integrated pest management* — This management approach seeks to limit pest damage while protecting the environment. It includes use of pest forecasting, use of crop rotations, repeated field visits, and use of smaller but better placed amounts of chemicals. A variety of pest-control strategies include: encouraging parasites or predators of pests; using pheromones; release of sterile males; planting resistant crops; and planting trap crops to lure pests from the major crop.

■ CASE STUDY

Integrated pest management in Indonesia

In the mid- 1970s in Indonesia, the rice-eating brown planthopper, a pest that supposedly had been eradicated by pesticides, began to attack improved rice crops that were considered pest-resistant. Seventy percent of Java’s rice crop was lost in one year. Scientific investigation indicated that pesticide use had initially destroyed the pests but had also destroyed their natural predators.

In 1986, the Indonesian government reduced pesticide subsidies and began to promote integrated pest management (IPM) to control pests using environmentally safe biological methods. These methods included advanced cropping methods, use of local varieties of rice, and minimum applications of pesticide. In 1989, the government withdrew the subsidies entirely. Since 1986, farmers trained in IPM reduced pesticide applications from 4,5 times to 0.5 times per season and rice yields increased. Furthermore, the country has saved more than \$100 million per year on pesticide imports.

■ REVIEW

Q. 1) *What are the most prevalent pest problems in your country? How are they managed? Does your country import pesticides?*

A. _____

Q. *Are air and water pollution considered important issues in your country? If not, why not? Is the average citizen aware of the effects of pollution on the atmosphere? Is the average citizen concerned about scarcity of water? Do they complain about the taste and odor of the water in major cities? Is water in your major cities considered safe to drink by foreigners? What disease may foreigners catch from the water? Are local people susceptible?*

A. _____

ANSWER (from page 52)

Private companies would have to pay for use of the resources they profit from. Governments could regulate the collection of biological material so that the resources would be a continuous source of revenue.

Q. What factors might induce a farmer change from traditional methods of agriculture to those which degrade the soils and environment?

A. _____

_____ 

ANSWER (for page 56)
Availability of seeds, fertilizers, pesticides, and herbicides may encourage farmers to plant monocultures. Also economic incentives to produce a certain crop may be influential. State farms may promote an example of monoculture.

PART 5

ENVIRONMENTAL MANAGEMENT RESOURCES

After reading this part of the module, you will be able to:

- *Discuss the content of an Environmental Overview.*
- *Identify tools to assist in environmental management.*
- *List agents of change for mitigation activities.*
- *Identify roles of UN agencies, national and international organizations and NGOs in environmental management.*

The final part of this training module will discuss some of the many resources at the disposal of environmental managers. A useful document to help assess required resources and to develop an approach to meeting problems is the UNDP's Environmental Strategy and Action Plan. This plan supports governments in integrating environmental management and awareness into their development plans. Although there are no simple rulers or recipes to make economic development strategies compatible with environmental goals, choices can be made which reflect an understanding of how the environment functions. What needs to be done is to identify means to protect, conserve, enhance and preserve the environment on a long-term basis and to link national objectives with environmental management activities.

Environmental management tools

The following tools are presented in the *UNDP Handbook and Guidelines for Environmental Management and Sustainable Development*. By focusing on environmental management and sustainable development and by encouraging popular participation in the formulation of programs, realistic alternative solutions may be found. The principles of environmental management, disaster mitigation and sustainable development should become part of daily activities and enable staff to identify environmental opportunities as well as constraints when pursuing economic and social development objectives.

Preparation of an Environmental Overview (EO)

The Environmental Overview is an assessment tool which provides basic information and assessment of the environment, at the country and the project level. These form the basis for the Environmental Management Strategy (the action plan which details parameters of the proposed project).

LEARNING OBJECTIVES

The outline for the EO is as follows:

1. Brief description of the natural environment of the country (or project area). This may include:
 - Environmental baseline data – elevations, precipitation, seasonal characteristics, rainfall, climate, temperature, existence of seismic faults, susceptibility to other natural disasters, population size, growth, and distribution.
 - Land ecosystems – plains, mountains, valleys, areas experiencing soil erosion and desertification.
 - Water ecosystems – main water bodies, international basins and underground waters.
 - Coastal and marine environments – description of the interface between land and water, presence of mangrove forests, fishing potential, ports, tourism.
 - Main non-renewable resources – oil and major mineral deposits, size and patterns of consumption, importance to economy and environment.
 - Biological diversity and renewable resources – main biological species and opportunities for use and conservation.
2. Description of main environmental issues.
3. Economic development and the environment – This section discusses whether the strategy for economic development adopted by the country includes a plan conducive to achieving environmental management and sustainable development including:
 - National development planning – environmental protection measures, plans to improve the resource base and environment.
 - Economic policies, incentives and regulations – cost to resources to service foreign debt, protection and enforcement mechanisms, subsidization policies such as for pesticides.
4. Ability of the country to achieve appropriate environmental management and sustainable development.
 - Enforcement of environmental policies, laws and regulations
 - Main environmental actors – government institutions, international organizations, NGOs and other associations, the role of women
 - Strength and capabilities of institutions
 - Environmental education and awareness programs
 - International assistance to protect and improve the environment
5. Likely environmental impacts associated with the implementation of the UNDP country program
6. Alternatives to the proposed country program.

Environmental impact assessments and management techniques

Environmental Impact Assessment (EIA) is an analytical process which provides decision makers with a prediction of possible consequences of a project so that the design may be altered if necessary. A qualified multi-disciplinary team is usually needed to carry out the EIA and requires the use of analytical capabilities, institutional support and monitoring powers.

Maps and overlay charts – This technique consists of overlaying a series of maps often made by computer, each containing data on environmental, social and economic variables, and then choosing a preferred combination of interactions. In disaster management, hazard mapping represents the results of hazard assessment, showing the frequency/probability of hazard occurrences of various magnitudes or duration.

Flow charts – These illustrate how different elements of the ecosystem are interrelated (simple flow charts are used in this module in Part two). Graphic modeling can enhance flow charts to show how modification of one element of a system effects others.

Environmental monitoring and decision making – Environmental monitoring systems provide information to help make better decisions and to evaluate programs in existence. Monitoring can be accomplished by sending individuals or groups to collect information or in other manners such as the analysis of satellite photography. Several international monitoring units keep tabs on natural phenomena and human-made hazards and can issue warnings. These include Tsunami Warning System, World Weather Watch Program, and UNEP's Global Environment Monitoring System (GEMS), which provides data on air and water pollutants.

Environmental legislation and zoning – These techniques enable the government to regulate human activities that impact the environment, and clarify to commercial and individual users what activities are permissible and forbidden and in some cases, what their responsibilities are if their activities harm the environment.

Mathematical models – Models have helped engineers to test the performance of proposed construction projects such as dams and pollution control. Models can also provide a better understanding of how chemicals behave in the air and cause smog. Other models, such as the input/output technique show the flow of goods and services measuring the efficiency with which natural resources are used.

Roles of individuals and organizations

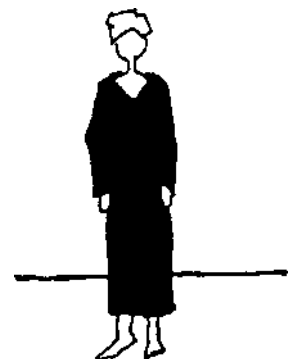
Agents of change

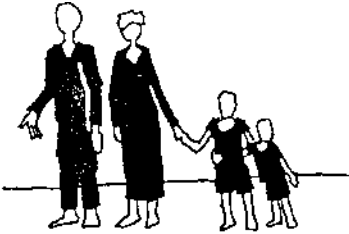
The process of mitigating environmental damage must target the components of human society that influence change. These are:

Individuals – Focusing on the individual, as the basis of enacting mitigation measure, is important for three reasons:

1. Individual judgments are involved in all responses within human systems – decision makers are influenced by individual inputs, either their own or their advisors.
2. The consequences of environmental change, whether good or bad, depend on the cumulative effects of large numbers of individual actions.
3. Individuals can be organized to influence social and political responses.

Special emphasis is placed on women and children as agents of change. Women, as major producers of food and agriculture in developing countries, can organize themselves to prevent further degradation. Their needs and views should be integrated into local efforts to conserve and rehabilitate.





Impoverished children suffer more than adults from degradation, yet, they will inherit the planet. Educated and aware children are among the best promoters of change in a society.

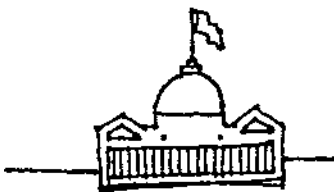
Sociocultural systems — The oldest forms of social organization — families, clans, tribes and other social units — are held together by bonds of duty, obligation, love, or solidarity; all of these bonds influence behavior in a manner separate from government or the marketplace. These systems are very important in terms of global survival because:

- a) Some of the very ancient social units may have developed means of survival that may be used by others; and
- b) Informal social bonds may significantly influence individual, community and government policy responses to environmental change.

Marketing Systems — Environmental change and the depletion of resources affects the prices of important commodities in local and world markets. Firewood and wood products are already scarce in many developing countries; in Nigeria, some families must spend up to one quarter of their income for wood fuel. In India, wood fuel is subsidized for the poorest of the poor to prevent their starvation.

Education and information systems — Environmental education must be fostered at every level by instilling an appreciation of the environment, and providing development alternatives less harmful to the environment as well as opportunities to participate in decisions regarding the environment.

Communities and non-governmental organizations — Communities, social movements, corporations, trade associations and volunteer organizations can significantly influence the adoption and implementation of government policies.



National policy — Countries influence global environmental change and its consequences through their roles in international agreements and through their own national policy decisions. Environmental, economic, agricultural and technological policies are important in determining response at community and individual levels.



International cooperation — An essential element in human response to environmental change is sustained international cooperation. The problem of global warming will difficult to solve without large-scale international effort, given that the diverse sources of greenhouse gases range from Asian rice paddies to tropical forests in Zaire. Further, some developing countries may require technological and financial assistance to solve their environmental problems.

Q. What human systems does one need to consider when planning mitigation measures for environmental degradation?

A. _____



National organizations

Every country is home to talented people who can be motivated to work against environmental degradation. Local organizations and individuals can be instrumental in mobilizing resources or inspiring others to do so. Examples are: women's groups, cooperatives, community groups, local leaders or chiefs, religious groups, and environmental groups. Schools and universities can mobilize large groups of students to participate in reversing environmental degradation while increasing their knowledge of the degrading processes. University professors and students can make valuable contributions to the knowledge base regarding the local environment.

The United Nations and other international agencies

Although the primary responsibility for reducing vulnerability rests with the government, the needs of developing nations are too vast to be dealt with solely by using local financing and technical assistance. Financing institutions such as the World Bank might assist with long-term financing.

The Joint UNEP/DHA Environment Unit was established as a joint project in July 1994 to bring together environmental and emergency expertise that could fill gaps in the existing response structure and avoid duplication of effort.

The Joint Environment Unit has been mandated to improve the international response to environmental emergencies by acting as a non-operational broker between affected and donating countries, a clearing house of information and a switchboard for disaster notification and alert.

UNEP provides funding and staff for the Joint Environment Unit while DHA provides access to the full range of their emergency response resources, including a 24-hour duty system. Partners include relevant international organizations including other specialized units within UNEP. The Joint Environment Unit has developed a network of National Focal Points in interested countries which aims as the conduit for information and assistance.

Other agencies – such as the United Nations Development Programme (UNDP), Department of Humanitarian Affairs (DHA), United Nations Environmental Programme (UNEP), United Nations High Commissioner for Refugees (UNHCR), Food and Agricultural Organization (FAO), International Foundation for Agricultural Development (IFAD), the OPEC fund, United Nations Industrial Development Organization (UNIDO), World Food

Programme (WFP), World Health Organization (WHO), United Nations Centre for Human Settlements (HABITAT), United Nations Educational, Scientific and Cultural Organization (UNESCO), and United Nations Children's Fund (UNICEF) – are among the agencies which can help with the preparation and implementation of national development and disaster mitigation plans.

In addition, donor agencies, international environmental groups, and international relief and development agencies can assist with training needs, the development of early warning systems, and by facilitating access to technological means – such as remote sensing – for assessing environmental degradation.

Non-governmental organizations

Non-governmental organizations (NGOs), and grassroots organizations are growing forces in the developing world, due to their ability to influence individual and community action. These organizations will likely play a larger role in the coming years. NGOs make numerous contributions to sustainable development:

- They mobilize local community energy and resources for long-term support of projects, enabling individuals to improve the quality of their lives.
- Through building alliances with other organizations, they can increase their own effectiveness and influence policy making.
- They can link the elements of sustainable growth: ecological, economic, political, and cultural.
- They can span the gap between local and technical knowledge to work toward long-term solutions that will be acceptable to target groups.
- They can enable individuals to cope with change, decreasing their vulnerability to disaster from rapid population growth, urbanization, and technological expansion.

Information shared among international NGOs may help to illustrate the common problems shared by disconnected communities. Local NGOs are able to share language and cultural understanding to seek ways to implement change. National leaders are wise to encourage NGOs as a means to enact government policy on local levels.

ANSWER (from page 61)

Individual perception, judgement, and actions; marketing systems; sociocultural systems; communities and organization; national policies; and international cooperation.

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