World issues:
A geographical perspective

Only study guide for **GGH1502**

DEPARTMENT OF GEOGRAPHY

Revised by:
Retha Coetzee

Acknowledgement to:
A Harmse, R W Pretorius, C Vlok, S Zietsman

Edited by:
Anneke Brits

Illustrations by:
Laura Steyn

Educational consultant:
Martsie Roman

Critical reader:
Michelle van Wyk

UNIVERSITY OF SOUTH AFRICA, PRETORIA

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CONTENT

Dear Student

We trust that you have already received and studied Tutorial Letter 101 to familiarise yourself with the content and structure of module GGH1502. The study guide comprises of study units that correspond to the chapters in your prescribed book by Middleton (2008). Every study unit is based on a chapter of the prescribed book. The study guide consists of 14 study units. We suggest that you systematically work through this study guide and complete all the activities given to you. Doing so will help you to understand the content easily. You cannot do the module without the prescribed book. The purpose of the study guide is to help you work through the prescribed book.

Begin each study unit by reading the introduction and the learning outcomes. Now systematically study the relevant sections in the prescribed book together with the study guide, atlas and DVD.

Knowledge of the causes, consequences, and distribution patterns of current world issues is particularly enriching to anyone regarding himself or herself as a responsible world citizen. We trust that you will find the study matter in this module interesting and stimulating and that the knowledge you acquire will heighten your awareness of the different factors that contribute to environmental degradation.

Wishing you all the best for your studies.

What you can expect in each Study Unit

Did you know?

The "Did you know?" inserts contextualise the content of each study unit and include interesting information, which you are not expected to learn.

Cartoon

Most of the cartoons illustrate the paradox or irony of environmental issues. The messages of the cartoons are meant to demonstrate the different views on and reasons for environmental degradation.

Sources to consult

A list of sources you need to consult appears at the beginning of each study unit, and consists of the following:

DVD: As you progress through the study material, you will be instructed to watch a specific clip relating to the particular study unit. The DVD is divided into clips. The number of the clip that you need to watch, is indicated in each study unit under the heading "Sources to consult".

***myUnisa*:** The Geography Department has a direct link to the journal *National Geographic*. You are advised to use this link to the website of the *National Geographic*, as it contains a lot of information on different environmental issues. The website links you to interesting articles, news snippets, photos and videos that will enhance your learning experience.

Atlas: An atlas is essential to enable you to achieve some of the learning outcomes of this module. Refer to Tutorial Letter 101 for more information. Use your atlas to find out where all the places, countries and phenomena you are learning about are located.

Prescribed book: Middleton, N. 2008. *The global casino: an introduction to environmental issues*. 4th edition. London: Hodder Arnold.

Learning outcomes

Learning outcomes state the skills and knowledge that you will be expected to demonstrate. Once you have reached these learning outcomes, you will have mastered the material in the study unit.

Introduction

In the introduction, we briefly explain the material in the study unit.

Content of the study guide

The material in each study unit corresponds to the learning outcomes and is based on the prescribed book. The material is divided into different sections, each with its own heading. In order to simplify things for you, the headings are identical to those in the prescribed book.

The following subheadings will guide you through the study material:

Reading activity

The chapter and the specific sections you need to study are indicated under this subheading.

Reading organiser

The reading organiser is a "planning tool" to help you summarise the material in the different sections of the prescribed book. The purpose is to highlight the essence of the specific section you had to read. The length of the discussions depends on the depth to which the topic is discussed in the prescribed book and the difficulty of the material.

Textbook activity

At the end of sections of study material you are given textbook activities which refer to specific sections in the prescribed book. Ensure that you do each activity before you proceed with the next section of the study material.

Study Unit 1

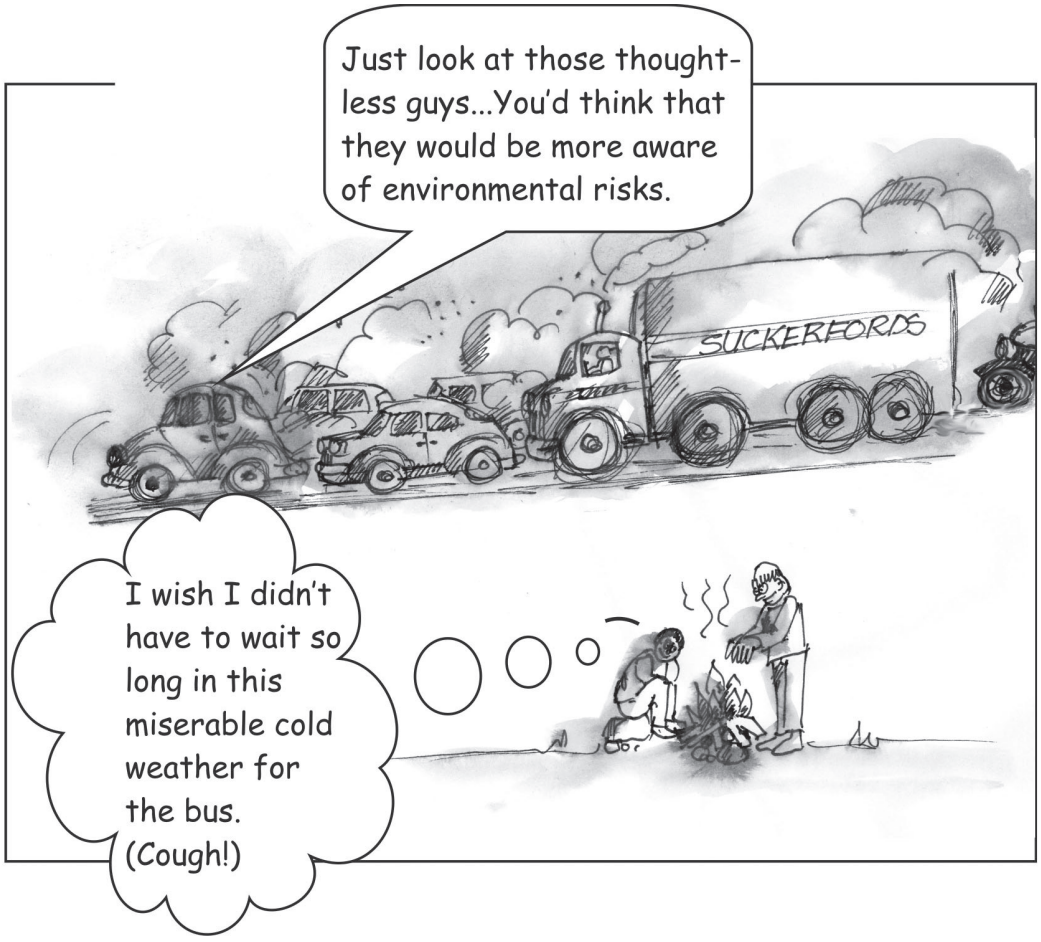
The physical environment

Did you know?

Our world can be divided into eight distinct biomes. Biomes, a term coined in 1967 by pioneer environmentalist Dr Dietrich Malinger, are ecological "districts" that have a distinct climate and topography. Not only does each biome look and feel different, each biome is also the habitat of a distinct set of plant and animal life.

The balance between organisms within a biome is very fragile and is easily disrupted. A meteorite impact is an extreme way of destroying a biome, but destruction of biomes is also continuously occurring as the result of human activities and occupation

(http://www.idiotica.com/cranium/encyclopedia/content/biomes.htm)



Sources to consult

DVD clips 1 & 2

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Biomes of the world

Atlas: World map on natural vegetation, annual rainfall, average temperature, morpho-climatic regions (biomes)

Prescribed book: Chapter 1, "The physical environment", on pages 1–18 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- distinguish between the four subsystems (spheres) as described
- explain the interaction between the different subsystems
- indicate the relationship between climate, location, amount of solar radiation and vegetation
- distinguish between the eight biomes on earth, and describe and indicate the location of each on a world map
- distinguish between the different time scales and spatial scales that geographers use in their study of the natural environment

Introduction

A biome is a large geographical area of distinctive plant and animal groups that are adapted to that particular environment. The climate and geography of a region determine what type of biome can exist in that region. Major biomes include deserts, forests, grasslands, tundra, and several types of aquatic environments. Each biome consists of many ecosystems, the communities of which have adapted to the small differences in climate and the environment of that biome.

All living things are closely related to their environment. Any change in one part of an environment, such as an increase or decrease of a plant or animal species, causes a ripple effect of change in other parts of the environment.

The earth includes a huge variety of living things, from complex plants and animals to very simple, one-celled organisms. However large or small, simple or complex, no organism can live alone. Each depends in some way on other living and nonliving things in its surroundings.

Climate is the reason why one area of the world is a desert, another a grassland, and a third a rainforest. Climate is the characteristic condition of the atmosphere near the earth's surface at a certain place on earth. Two of the most important factors determining an area's climate are air temperature and precipitation. World biomes are controlled by climate. The climate of a region will determine what plants will grow where and which animals will inhabit it. All three components, namely climate, plants, and animals, are interwoven to create the fabric of a biome (Strahler et al 1984).

Classifying the natural world

Reading activity

Study the section "Classifying the natural world" on pages 1–6 in Middleton.

Reading organiser

- The natural world of the human environment can be divided into the following four subsystems:
  - the lithosphere
  - the atmosphere
  - the hydrosphere
  - the biosphere
- Geographers do not study the individual aspects of these subsystems; the emphasis falls rather on the interaction between people and phenomena within these subsystems, and on the way in which interactions vary in space and over time.
- People and their activities have influenced all these subsystems over time, just as aspects of the natural subsystems have influenced human activities.
- There is a dynamic interaction between the four natural subsystems of the human environment.
- The atmosphere surrounding the earth is a mixture of gases that extends to a height of approximately 480 km above the earth's surface.
- The hydrosphere is the water realm of the earth and includes the following:
  - oceans
  - surface water (in lakes, rivers and streams)
  - groundwater (in soil and rocks)
  - water vapour (in the atmosphere)
  - ice
- The solid outer section of the earth's crust is known as the lithosphere. Weathering occurs where the lithosphere is exposed to the atmosphere. This gives rise to the formation of soil, which, together with oxygen and water, is fundamental to life on earth.

- The atmosphere, lithosphere and hydrosphere function together to create the environment of the biosphere.
- The biosphere embraces all living organisms on earth, including humankind, and extends from the depths of the ocean right up to the lower layers of the atmosphere.
- Ecology is the study of the relationships and interactions between living organisms as well as those between the organisms and their natural environment.
- The environment and the collection of living organisms on earth (in the biosphere) that interact with one another and with their nonliving environment, can be described as the ecosphere.
- From a biological viewpoint, ecosystems are regarded as the result of the relationships and interactions between biotic (living) and abiotic (nonliving) components.
- There is a delicate balance between the different components in an ecosystem, and a disturbance in one of these components affects the others.
- There are eight biomes described by ecologists, each with specific characteristics and each occurring in specific parts of the world.
- Certain criteria are applied to differentiate between morphoclimatic regions on a global scale.
- How does geographic location determine biome type?
- How does the amount of solar radiation determine biome type?
- How do temperature range and amount of precipitation influence a biome?

Textbook activity

- With the aid of appropriate examples, distinguish between the four subsystems of the natural environment.
- Explain what an ecosystem is.
- Indicate what a morphoclimatic region is, and what criteria are used to differentiate between various types of regions on a global scale. Describe the characteristics of each of the eight biomes or morphoclimatic regions distinguished on pages 2–6 in Middleton.

Time scales, Spatial scales, Time and Spatial scales

Reading activity

Study the sections "Times scales", "Spatial scales", "Time and space scales" on pages 9-16 in Middleton.

Reading organiser

- Our knowledge and perception of the influence of humans on the natural environment vary depending on the period and the spatial extent according to which we measure it.

- Time scales range from the geological time scale, which is measured in millions of years, to human time, which is measured in days, years and decades.
- The effects of human activities on the natural environment and environmental change manifest differently according to the time scale that is used.
- In a study of environmental change, choosing a suitable spatial scale is just as important as choosing an appropriate time scale.
- Spatial scales range from the microscopic to the macro level of the world.
- Humans are the central point of reference in geography; therefore, geographers focus their studies on spatial and time scales that are significant to humans.

Textbook activity

- How old is the earth, and how long have modern humans *(homo sapiens)* been living on earth?
- "Although natural processes have changed the earth over thousands and millions of years, some of these processes have had a drastic and immediate effect on people and their environment." Explain what this statement means.
- Explain what the dynamic equilibrium in a natural system means. Give appropriate examples to explain the concept of feedback, and to illustrate the distinction between positive and negative feedback.
- With the aid of an appropriate example, explain what a threshold in the natural environment is. What effect does time lag have on exceeding a threshold?
- Study the five typical changes in figure 1.11 on page 13 in Middleton.
- What type of change to the ecosystem do you think the following events or conditions would bring about?
    - a nuclear bomb explosion that destroys everything within a radius of 50 km; exposes people, animals and plants over a large area to serious nuclear radiation; and eradicates certain plant and animal species
    - serious droughts that ravage the southern parts of the African continent every nine years
    - a volcanic eruption
    - the continuous burning of fossil fuels, resulting in a gradual rise in the concentration of carbon dioxide in the atmosphere
    - the total deforestation of an area of 1 000 square kilometres in the tropical rain forests of Africa
    - the extinction of the dominant species in an ecosystem
    - veld fires in the Kruger National Park started by lightning every few years
    - veld fires that are started at least once a year along major highways as a result of people's negligence
    - the wrecking of an oil tanker, causing many kilometres of the coastline to be covered in a layer of crude oil
- Give appropriate examples to illustrate how the significance of human impacts on the environment decreases as the spatial scale increases.

Conclusion

Knowledge of the composition and functioning of the subsystems of the natural environment alone is not sufficient for an understanding of global environmental problems from a geographical perspective. The geographer's field of study is the human environment, and therefore people's interaction with both the natural and the human environments. We should therefore also investigate the components and the functioning of the human environment.

Study Unit 2

The human environment

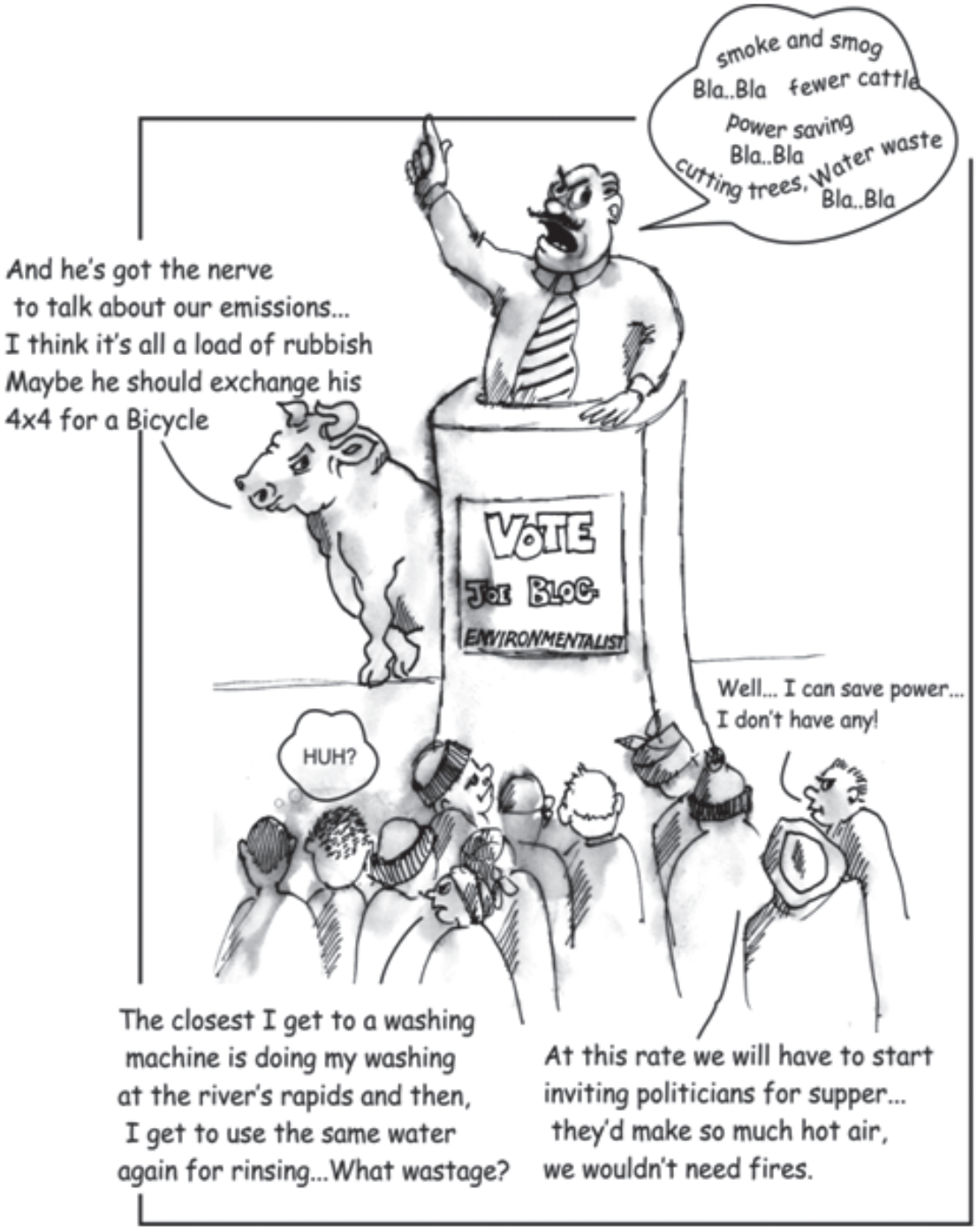
Did you know?

Since 1950, the richest fifth of humanity has doubled its consumption of energy, meat, timber, steel and copper per person and quadrupled its car ownership, while the poorest fifth of humanity has increased its general consumption hardly at all.

Since 1972, the main driving force leading to pressure on land and water resources has been an increase in food production. In 2008, some 2,5 billion more people needed food than in 1972. The trend in recent years has shown population growth drawing ahead of food production in some regions of the world, particularly Africa. Some commentators believe that China may soon become a major food importer.

In 2006, the Food and Agriculture Organization (FAO) estimated there are still 820 million hungry people in developing countries – 20 million more than in 1996. In addition, there are 25 million hungry people living in transition countries and another 9 million in industrialised countries, bringing the total number of malnourished people in the world to 854 million.

Humanity will have to undergo a "revolution in thinking" in order to deal with the doubling of urban populations in Africa and Asia. By 2030, 5 billion people (over 60 per cent of the world's population) are expected to live in towns and cities. Some 600 million city dwellers are today without adequate shelter and over 400 million do not have access to the simplest latrines (http://www.peopleandplanet.net/doc.php?id=199&section=2, accessed 30 April 2009).


smoke and smog
Bla..Bla fewer cattle
power saving
Bla..Bla
cutting trees, Water waste
Bla..Bla
And he's got the nerve
to talk about our emissions...
I think it's all a load of rubbish
Maybe he should exchange his
4x4 for a Bicycle
VOTE
JOE BLOG
ENVIRONMENTALIST
HUH?
Well... I can save power...
I don't have any!
The closest I get to a washing
machine is doing my washing
at the river's rapids and then,
I get to use the same water
again for rinsing...What wastage?
At this rate we will have to start
inviting politicians for supper...
they'd make so much hot air,
we wouldn't need fires.

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Debate environmental degradation

Atlas: Map on population growth

Prescribed book: Chapter 2, "The human environment", on pages 20–36 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- compare the various environmental schools of thought of the 20th century
- evaluate the reasons for the differences between the "rich North" and the "poor South"
- analyse why some environmental schools of thought are classified as technocentric and others as ecocentric
- explain why certain environmental problems have begun to gain popular political acknowledgement in the past couple of decades
- explain why people have to change their life and world views

Introduction

The danger of environmental change and degradation is inherent in people's use of natural resources. Environmental pollution is therefore not a new problem of the 21st century, but an old problem that is now growing in intensity and size because of growing population numbers and the ever-increasing rate of resource consumption. The cumulative effect of human activities, as we see it in modern industrialisation and population growth, has now begun to endanger the life-sustaining function of the natural system. Due to modernisation and industrialisation, the use of fossil fuels, for instance, has increased along with the release of noxious gases, which increases air pollution.

The change in the world's climate is also a sign of environmental degradation. In addition to the atmospheric problems, there are the degradation of natural forests, the extermination of species and the loss of biodiversity, the exhaustion of soil and water resources, and the accumulation of waste in the natural environment.

Because environment deterioration is such a complex problem, we do not usually see the warning signs in time. In many instances, the damage has already been done by the time the problem becomes obvious. Today most informed people are, however, aware of conditions in the human-environment system, of environmental issues and of the survival crisis that the world is facing. They realise that the cur-

rent social, economic and political systems in the world do not operate in favour of the environment, and that we are using the earth in a unsustainable way.

Human perspectives on the physical environment

Reading activity

Study the sections "Human perspectives on the physical environment" and "Human forces behind environmental issues" on pages 20–25 in Middleton.

Reading organiser

- Perceptions and evaluations of resources, and adaptation to them, differ from person to person, from place to place and from time to time in the human-environment system.
- Environmental issues stem from the abuse of the natural environment.
- The impact of population growth.
- The Malthusian perspective.
- The impact of technology.
- The Boserups theory.
- The impact of socio-cultural organisation.
- Imbalances between richer and poorer nations.

Textbook activity

Based on the information you have just read, interview a person older than 60 years about his or her attitude towards conservation. You can ask the following questions:

- Do you think your generation's attitudes are significantly different from your parents'?
- If it has changed, what do you think can be the reasons? Why do you think there is a gap between what people say regarding conservation and how they act?

Reflect on the following questions before you continue with your next activity:

- Why do you think there is such a gap between what people say and what they do regarding conservation?
- Why do you suppose people "loath to change their lifestyles"?
- Do you agree that "energy use is a reflection of the strength of our economy"?
- What is the definition of a "consumer"? What is the definition of "responsible citizen"?
- Can a person be both when it comes to energy consumption? How?

Human-induced imbalances

Reading activity

Study the section "Human induced imbalances" on pages 25–32 in Middleton.

Reading organiser

- Human activities display an uneven spatial pattern.
- Certain areas of the world are economically and technologically advanced while others are less developed.
- Differences in standard of living and the level of economic development between people in the so-called developed (or "rich'') and those in the developing (or "poor'') countries of the world (fig 2.5).
- Developed countries are inclined to dominate developing countries economically, which gives rise to a process of underdevelopment and dependence.
- The economies of developing countries are based largely on a single primary commodity or a few commodities (such as coffee, cotton, copper or gold), which are exported to developed countries.
- Developing countries have a high commodity concentration index, and their economies usually include only a few forms of economic activity.
- Developed countries control developing countries to the extent that the latter actually have very little say over their own economic affairs.
- Transnational corporations (TNCs), which have their origins in developed countries, are regarded as the instruments of this economic dominance and exploitation.
- A TNC is an individual business which, besides producing in its country of origin, is also responsible for production in other countries.
- TNCs are usually very large companies whose operations extend across national borders and whose global operations are usually controlled centrally from one of the countries in the rich North.
- The global turnover and flow of goods, capital and information between TNCs are becoming increasingly important, and are already starting to exceed that of individual states in the world.
- TNCs are regarded as the instruments of development in the South, but the industrialisation and economic development processes that they initiate, often give rise to environmental problems in developing countries.
- The spatial patterns of exploitation and dependence can be observed on all geographical scales – from the global to the local.
- Many of the factors that play a role in uneven global spatial patterns are also significant on a national scale (within individual states).
- In both the North and the South urban and rural areas, differ with regard to their levels of economic development.
- Inhabitants of rural areas in the South are usually the worst off economically, which influences their interaction with the natural environment.

- The poor and disadvantaged, particularly in the South, are both the victims and the agents of environmental degradation.

Textbook activity

Debate the following statement: 'Inhabitants of rural areas in the South are usually the worst off economically, which influences their interaction with the natural environment.'

Interest in environmental issues

Reading activity

Study the section "Interest in environmental issues" on pages 33–36 in Middleton.

Reading organiser

- Note the various views of environmentalists during the last half of the 20th century.
- The ecocentric and technocentric view on the environment.

Textbook activity

- Explain the relationship between population size and density on the one hand and human impacts on the natural environment on the other.
- What does the term "environmental degradation'' mean?
- Explain the relationship between technology and environmental degradation.
- Explain how economic, political and social values influence environmental change.
- Name the two main turning points in the history of humankind.
- What were the economic and social consequences of these revolutions, what effect did they have on the environment in the past, and how are they still effecting it?

Conclusion

The causes of the environmental, resource and social problems confronting the world are complex. They are associated with population growth; rural-urban population distribution; poverty; structural imbalances or inequalities in the political, economic and social arenas; the overutilisation and misuse of resources; a loss of biodiversity; the inability of humankind to consider the needs of future generations in its present utilisation and exploitation of the environment; and the faith of humankind in technology.

Today, people dominate the human-environment system in terms of numbers, spatial distribution, technology and resource utilisation. Despite this dominant position, approximately one-fifth of the world's population is impoverished, experienc-

ing critical living and environmental conditions. On a global scale, the gap between the rich and poor countries, is increasing. One out of every five people in the world enjoys a good quality of life, another three have an acceptable quality of life, while the fifth person lives in poverty. Environmentalists believe that the present forms of economic growth in the countries of the North are unsustainable, and that total resource consumption in the world will have to increase seven times if all people on earth are to enjoy a quality of life similar to that enjoyed by the average resident of the USA. However, we live in a finite world with limited quantities of natural resources. The environment would not be able to support the present world population if all people were on the same level of development as that of the world's rich countries.

Study Unit 3

Sustainable development

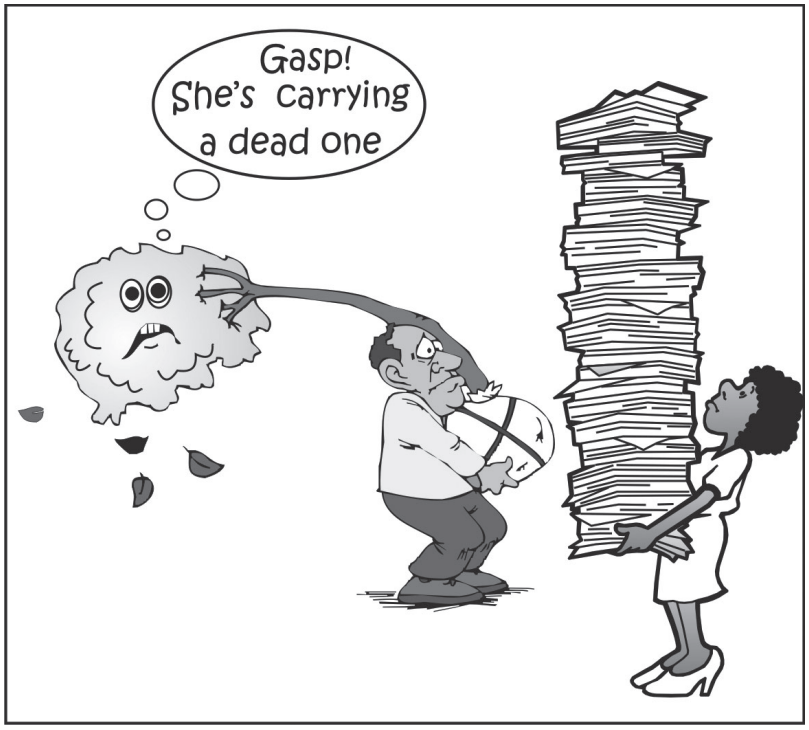
Did you know?

In western Africa, just south of the Sahara Desert, lies the landlocked nation of Burkina Faso. Despite the limited natural resources in this arid savannah, the nation experienced a 200 percent increase in urban population between 1975 and 2000. Much of that growth occurred in the capital city of Ouagadougou, where unplanned settlements sprang up along the city's perimeter. Between 1960 and 1993, Ouagadougou experienced a 14-fold increase in area.

UNEP found that, in the 1980s, Ouagadougou's growth resulted predominantly from rural-to-urban migration. After that time, the population increased primarily from natural growth – birth rates exceeding death rates.

The growth led to an explosion of unplanned settlements. Unplanned settlements may conflict with sustainable development goals, and they make it harder for the government to provide basic services, such as drinking water.

Despite growing urbanization, however, the United Nations Environment Programme (UNEP) found that Burkina Faso made progress in some key areas of environmental sustainability. Protected areas increased slightly from 1990 to 2005, and per capita carbon dioxide emissions dropped slightly over roughly the same period (http://earthobservatory.nasa.gov/IOTD/ view.php?id=8870, accessed 30 April 2009).



Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Sustainable development

Prescribed book: Chapter 3, "Sustainable development", on pages 43–55 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- explain the term "sustainable development" and its importance
- discuss how economic principles and environmental economics can influence sustainable development
- compare the benefits and disadvantages of scientific and technological developments

Introduction

Since the Industrial Revolution, it has been generally accepted that industrialisation is the path to modernisation and progress for humankind. Industrialisation has, however, been accompanied by environmental degradation. People initially believed that environmental degradation was an acceptable price to pay for economic progress. However, in 1987, in their publication *Our common earth,* also known as the Brundtland report, the World Commission on Environment and Development (WCED) came to the conclusion that economic development could not continue at the expense of the natural environment. They proposed a new type of development, which they called "sustainable development". With sustainable development, the needs of the current generation are satisfied without endangering the ability of future generations to satisfy their needs. Sustainable development requires that the use of resources be regulated in such a way that the greatest possible return is ensured for the greatest number of users over the longest period.

"Sustainable development" has become a very popular term, and means different things to different people. Sustainable economic development, for example, is defined as maintaining an optimal level of interaction between the biological system (the biosphere), the economic and the social systems. Sustainable development requires economic production to take place in harmony with natural resources – never at the cost of the environment and environmental resources, which are essential for maintaining life on earth.

When the term was first used, the emphasis was on human needs rather than the interaction between the socioeconomic and the natural systems. Today it is accepted that sustainable development has to do with maintaining a balance between satisfying human needs (economic development) and preserving the natural envi-

ronment in which people live and on which they depend to satisfy their basic needs. Sustainable development is economic development that increases wealth but avoids environmental degradation. It is not easy, however, to define sustainable development in a way acceptable to everyone.

Sustainable development

Reading activity

Study the section "Sustainable development" on pages 43–45 in Middleton.

Reading organiser

- The priorities as described in the World Conservation Strategy document.
- The differences between the various world views on sustainable development.
- The meaning of "maximum sustainable yield".
- Three generally accepted principles of sustainable development.

Textbook activity

- According to the World Conservation Strategy, what three priorities should be included in all development programmes in order to make them sustainable?
- What is the difference between the economic and the deep ecology world views on sustainable development?
- Distinguish between ecological and economic sustainability using appropriate examples.
- What does maximum sustainable yield mean?
- What are the three generally accepted principles of sustainable development?
- Now that you have read all the different meanings of sustainable development, briefly write down what you think the main principles of sustainable development are against the background of your own life and world view.
- What are the main principles of sustainable development if the priorities of the natural environment are taken as our point of departure?

Valuing environmental resources and growth and development

Reading activity

Study the sections "Valuing environmental resources" and "Growth and development" on pages 46–50 in Middleton.

Reading organiser

- The root cause of environmental degradation according to economists.
- The two types of values according to which the elements of the natural environment are classified.

- The view of the World Commission on Environment and Development (WCED) on sustainability.
- Economic growth versus the qualitative improvement of the human population.
- The rules that need to be applied for sustainable development to succeed in terms of inputs and outputs, according to cycle C in figure 3.4 on page 42 in Middleton.
- The adaption of gross national product (GNP) to meet the requirements of sustainable development.

Textbook activity

- What is the root cause of environmental degradation according to economists?
- Explain in your own words what environmental economics entail, and why application of the principles of environmental economics are seen as a way of slowing down environmental degradation.
- Are the principles and approaches of environmental economics perfect and without problems? Give reasons for your answer.
- According to which two types of values are the elements of the natural environment classified? Give specific examples to illustrate your answer.
- Some people argue that parts of the natural environment lie beyond the scope of environmental economics. In environmental economics, only the prices of products are considered, and not the value people attach to their environment. Explain this statement.
- Can people be compensated in monetary terms for something that has an intrinsic value for them? Give at least one example of an element in the natural environment that has value for you that cannot be expressed in terms of money – something that you and your community would not give up for all the money in the world.
- Is economic growth (the quantitative expansion of the economic system) essential for development (the qualitative improvement of the human population)? What is the view of the WCED?
- Which two types of reaction did the WCED get to their call for sustainable development?
- Discuss the rules that need to be applied for sustainable development to succeed in terms of inputs and outputs and according to cycle C in figure 3.4 on page 42 in Middleton.
- How do we have to adapt the measure of GNP to meet the requirements of sustainable development?

Population and technology

Reading activity

Study the sections “Population and technology”, “Carrying capacity” and “Population” on pages 50–55 in Middleton.

Reading organiser

- Three factors that can be used to keep the throughput of energy and matter in the natural system within the system's capacity.
- Control over the throughput in the system.
- The term ''carrying capacity''.
- Malthus's and Boserup's theories.
- Elements in the natural environment are constant and limited, and occur in given amounts.
- Natural resources in the human-environment system are not constant and amounts are not limited.

Textbook activity

- What three factors can be used to keep the throughput of energy and matter in the natural system within the system's capacity?
- Is sustainable development the same as control over the throughput in the system? Give reasons for your answer.
- What does ''carrying capacity'' mean? Can we successfully apply the concept to human population growth? Give reasons for your answer.
- Explain how Boserup's theory differs from Malthus's theory.
- "Although natural elements occur in the natural environment in constant, limited and given amounts, natural resources in the human-environment system are not really a given constant and amounts are not really limited.'' Explain what this statement means.

Conclusion

Geographers are interested in the relationship between socioeconomic development and the natural environment, in people's impact on the natural environment, in the nature and consequences of environmental change, and in the repercussions of this change for current and future generations. We have to realise that we live in a finite world. Whether we are motivated by religious convictions or by a need to ensure the widest possible ecological choice for humankind, we remain responsible for leaving the earth in a habitable state for our descendants. Each individual on earth counts, and if everyone does his or her bit to conserve the environment, we might be able to leave our children a better earth than the one we are living on now. However, this means that people will have to change their view of life and the world. We will have to put all our efforts into regulating the use of resources in such a way that we can ensure the greatest possible returns for the greatest number of consumers over the longest possible period.

Food for thought:

- The rich must live more simply, so that the poor may simply live.
- Is development without an increase in throughput really possible?

- South Africa is often described as a microcosm of the world, because it has both First-World and Third-World characteristics. With this in mind, what approach to development would be best for this country?

Study Unit 4

Tropical deforestation

Did you know?

Between 1960 and 1990, most of the deforestation occurred globally, with an increasing trend every decade.

Brazil has the highest annual rate of deforestation today. The Atlantic coast of Brazil has lost 90–95% of its rainforest, Central America 50%, South America 70%, the Philippines 90% and Madagascar 95%. El Salvador has lost 70–85% of its rainforest due to heavy bombing during the civil war of 1984–1985. Sumatra has only 15% of its rainforests left. Only 6% of Central Africa's forests are protected by law (www.globalforestwatch.org/english/centralafrica/news.htm).

Resources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Tropical deforestation

Atlas: World map on different biomes and land use

Prescribed book: Chapter 4, "Tropical deforestation", on pages 57–76 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- indicate the spatial distribution of the phenomenon of deforestation on a world map
- explain the reasons for the destruction of the tropical rainforests
- discuss the consequences of the destruction of the tropical rainforests
- suggest solutions to decrease deforestation rates
- explain how tropical rainforests can be utilised in a sustainable manner

Introduction

Although deforestation has largely been stopped in the temperate latitudes of the northern hemisphere, it is occurring more and more in the tropics and thus reaching alarming proportions in that part of the world.

Despite the ongoing reduction in deforestation over the past 30 years, the process of deforestation remains a serious global ecological problem and a major social and economic problem in many regions. The rate of deforestation also varies widely by region, and despite a decline in some regions, the rate of deforestation is increasing mainly in developing tropical countries**.** Africa is suffering deforestation at twice the world rate, according to the UN Environment Programme (UNEP).

The reasons for deforestation in the humid tropics are complex and can be seen as the result of a series of related processes. Although it is widely accepted that forests are destroyed to increase the economic value of land, there is no agreement on what the causes of deforestation are. There are many causes for this phenomenon, such as corruption, an unequal distribution of wealth and power, population growth, and urbanisation.

The loss of tropical forests has consequences that vary from local to global. Deforestation presents multiple societal and environmental problems. The immediate and long-term consequences of global deforestation endanger life on earth. Some of these consequences include loss of biodiversity, disruption in the flow of water and nutrient cycles, the destruction of forest-based societies, and climatic disruption.

The conservation and management of forests in the humid tropics is an issue receiving increasing attention at all levels – from the local to the international. Many initiatives have already been launched, including action plans and "debt for nature swaps", which entails the writing off of foreign debt in exchange for conserving specific forested areas. Developing countries need to be convinced of the benefits of conserving forests before they are prepared to participate actively in conservation activities.

Deforestation rates

Reading activity

Study the section "Deforestation rates" on pages 57–59 in Middleton.

Reading organiser

- The evolution from hunter-gatherers to more advanced economic systems was one of the first steps to deforestation.
- There are many examples of deforestation during the various periods in human history.
- Deforestation has largely been halted in the **temperate latitudes** of the northern hemisphere, but in the **tropics** there is an increase in deforestation.
- There is uncertainty regarding deforestation rates, partly because there is no standard definition of deforestation.
- Note the difference between deforestation and the degradation of forests.
- Contemplate the global distribution of the phenomenon of deforestation.

Textbook activity

- Study figure 4.1 on page 58 in Middleton. Use an atlas and write down the names of countries in which deforestation is increasing by more than 0,6% per annum.
- Study figure 1.1 on page 3 in Middleton. Use an atlas and write down the names of countries situated in the humid tropical biomes.
- In which biome/s is/are deforestation the most prevalent?
- Describe the relation between deforestation rates and the various biomes.

Causes of deforestation

Reading activity

Study the sections "Causes of deforestation" and "Direct wartime impacts" on pages 59–63 and 401–402 in Middleton.

Reading organiser

- Note the main reasons for deforestation in each of the following areas in the humid tropics: Latin America, Africa, South Asia and South-East Asia.
- Direct wartime impacts on deforestation include the cutting down of England's oak trees decades ago to build warships, and the extreme destruction of dense vegetation during the Vietnam War.
- Because of agriculture and commercial forestry, large areas of indigenous forest were also lost during the Vietnam War.
- The mangrove forests in Vietnam were halved during the war.
- Note the example of West Africa, and specifically Cote d'Ivoire, where deforestation can be traced to the government's view that indigenous forests are a source of income and foreign currency for reducing the country's enormous foreign debt.
- Commercial forestry and agriculture can also be regarded as primary causes of deforestation in the Philippines.
- The impacts of cattle ranging, mining, and slash-and-burn activities in the tropical rainforests of the Amazon should be examined.
- Government policy can play a role in deforestation, as was illustrated in the deforestation of the Amazon basin.

Textbook activity

- What are the main causes of deforestation in tropical Africa?
- What led to the overexploitation of tropical rainforests in Cote d'Ivoire?
- When did large-scale deforestation begin in the Amazon basin, and what role did government policy play in this?
- Study the spatial pattern of deforestation in figure 4.4 on page 63 in Middleton. Explain the reason for the distinctive herringbone pattern.
- Do you think that the spatial patterns of deforestation in tropical Africa look like those in figure 4.4 on page 63? Give reasons for your answer.
- Explain why logging can be seen as one of the major causes for the demise of the African forest.
- To what extent does poverty contribute to the large-scale deforestation of the tropical rainforests?
- Do you agree that all deforestation is due to the need for land for use in agriculture, logging, infrastructure projects, and other human activities?

Consequences of deforestation

Reading activity

Study the section "Consequences of deforestation" on pages 63–70 in Middleton.

Reading organiser

- Deforestation has a huge impact on the natural and human environment, for example on hydrology, soil, climate, biodiversity, and indigenous people.
- Extinctions – loss of biodiversity of microbes (bacteria), plants, insects, animals, indigenous peoples, etc.
- Habitat fragmentation. This disturbs animals' habitat and may force them to enter habitats that are already occupied.
- The fragmentation of habitat can pose many problems, such as territorial conflicts, homelessness (loss of habitat), lack of food availability, migration disturbances, etc.
- Soil erosion occurs when trees and plants are removed; the rainwater washes nutrients in the topsoil away.

Textbook activity

- Study the list of consequences of deforestation as mentioned. Distinguish between the environmental and socio-economic impacts. Determine whether the impact will be on the climate, hydrology, biodiversity or people living in the area. Provide your answer in table format.

Environmental impacts	**Socio-economic impacts**

Tropical forest management

Reading activity

Study the section "Tropical forest management" on pages 70–76 in Middleton.

Reading organiser

- Conservation legislation is often of absolutely no value in practice. Consider the role of socio-economic policy in solving the problem of deforestation.
- Many people depend on forests for their survival. Banning the utilisation of forests is not a viable solution for the problem.
- The meaning and influence of "eco-imperialism" as a reason for deforestation.
- The contribution of outsiders, for example the World Bank or other institutions, to deforestation.
- The pragmatic approach to the problem of deforestation requires surveys and extensive evaluations of the environment.
- Conservation can be seen as the only option.
- Sustainable forestry to avoid radically altering the structure of forests.

- The granting of longer concession periods could induce lower impact tree-felling.
- Greater emphasis on forestry products other than wood.
- Control of forestry resources through small-scale rather than national and international involvement.

Textbook activity

- Do you think that a ban on the utilisation of the rainforest will be a solution to the issue of deforestation? Give reasons for your answer.
- Money will solve the environmental issue of deforestation. The contribution of outsiders, for example the World Bank or other institutions, is therefore vital. Do you agree? Explain your answer.

Conclusion

I thought a good way to conclude this study unit, would be by quoting from an address by Dr Andrew Mitchell of the Global Canopy Program.

Speaking to an audience of more than 500 scientists at the annual meeting of the Association for Tropical Biology and Conservation, Mitchell said the world presently faced a crisis of values, which translated to threats to food security, energy security, and environmental security.

These are combining to create a kind of a perfect storm that we have going on right now. You see it in rising food prices, rising energy prices, and a great land grabs to produce biofuels. The easiest way to grow these crops is to grab lands in the tropics ... from rainforests.

Meanwhile the developing world sees climate change as a train crashing through their countries, but something that is not their fault. Forests fall because they are more worth cut-down than standing.

Taxes by governments are not going to be enough to fund forest conservation efforts on the kind of scale that is going to be needed to have a real impact, but for a market, $10–15 billion is quite manageable. That is about what we drink in wine and champagne every year in Britain. For a fraction of the percent of the three trillion dollar-a-year [sic] insurance businesses, we could save forests. The central issue in this whole debate is how we put a true value on standing rainforest to the world community. It is time to stop talking and start acting (www. illegal-logging. info/item_single.php?item...id, accessed 30 April 2009).

Study Unit 5

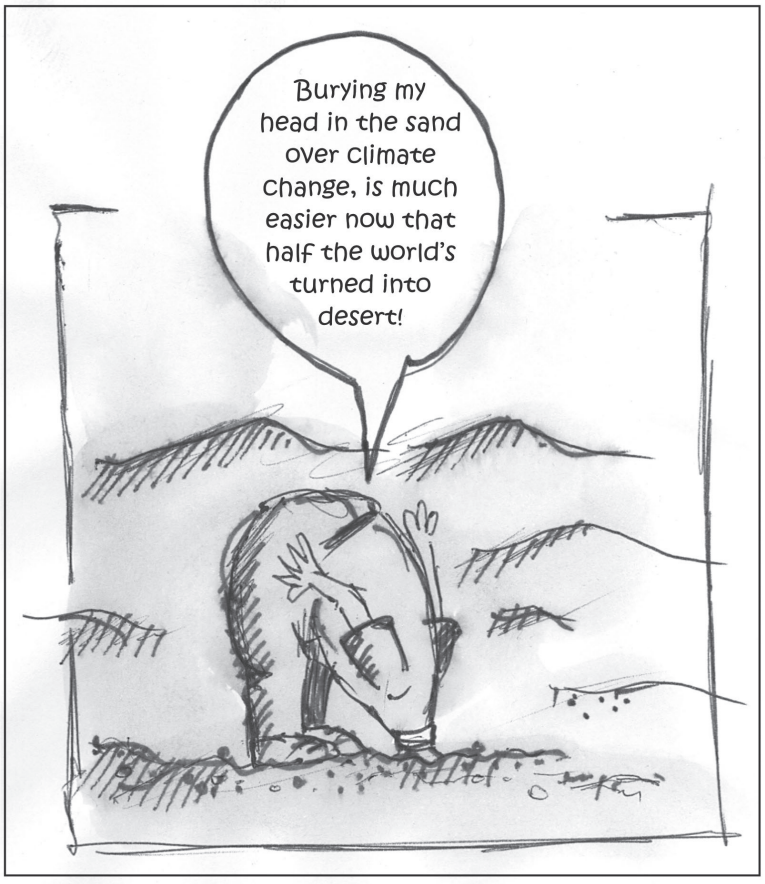
Desertification

Did you know?

About one third of the world's land surface is arid or semi-arid. It is predicted that global warming will increase the area of desert climates by 17% in the next century. The area at risk to desertification is thus large and likely to increase.

Worldwide, desertification is making approximately 12 million hectares useless for cultivation every year. This is equal to 10% of the total area of South Africa or 87% of the area of cultivated lands in our country.

In the early 1980s it was estimated that, worldwide, 61% of the 3 257 million hectares of all productive drylands (lands where stock are grazed and crops grown, without irrigation) were moderately to very severely desertified. The problem is clearly enormous (http://www.deltaenviro.org.za/resources/envirofacts/ desertification.html, accessed 30 April 2009).



Sources to consult

DVD clip 4

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Desertification

Atlas: World map of the world's drylands

Prescribed book: Chapter 5, "Desertification", on pages 79–98 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- define the term "desertification"
- classify and explain the causes of desertification
- locate the countries within the Sahel Region on a map of Africa
- analyse how population growth in the Sahel results in desertification

Introduction

Desertification means the transformation of arable or habitable land into a desert because of a change in climate or destructive land use. This process leads to land degradation specifically in areas (ecosystems) characterised by a lack of water resources. These areas are referred to as drylands – see figure 5.1 on page 82 in Middleton.

Desertification occurs when the capacity of the land (an area, ecosystem or environment) to produce biomass declines to such a low level that it is no longer able to support its characteristic plant cover on a permanent basis.

This can be regarded as the eventual, catastrophic consequence of soil degradation, because once the soil has been irreversibly degraded, the productivity of the ecosystem is lost forever.

The drive to use larger soil surface areas (and new areas) for agricultural purposes has led to situations in many parts of the world where marginal and submarginal soils are utilised as areas for crop cultivation and grazing. Marginal areas are those areas in which crop production or animal husbandry in any year has only a 50% chance of being successful. In submarginal areas, the probability of producing profitable outputs in any year is even lower than 50%. The years in which the outputs do not generate profits, are usually those years characterised by setbacks such as droughts, floods, cold hail damage and plaques.

Definition of desertification and areas affected

Reading activity

Study the introductory section, "Definition of desertification", and "Areas affected by desertification" on pages 79–83 in Middleton.

Reading organiser

- Desertification is not exclusive to the present time.
- The link between soil utilisation and soil degradation.
- At the United Nations Convention to Combat Desertification, desertification and the "spreading of deserts" were described.

Textbook activity

- Indicate whether you agree or disagree with the following statement, and give reasons to substantiate your viewpoint: "Desertification is a phenomenon that is unique to the present time."
- What does the statement mean that the modern viewpoint on desertification accepts that there is a close association between soil utilisation and soil degradation?
- How were desertification and the "spreading of deserts" described at the UN Convention to Combat Desertification?

Causes of desertification

Reading activity

Study the introductory paragraph under the heading "Causes of desertification" on pages 83–84 in Middleton.

Study the causes of land degradation in table 5.2 on page 84 in Middleton.

Reading organiser

- The causes of desertification are summarised according to four physical processes, namely:
  - overgrazing
  - overcultivation
  - overutilisation of vegetation
  - salinisation of soil under irrigation

- These are the processes that cause desertification. At the root of this environmental problem, however, are the socio-economic and political situation of an area and the reasons why people misuse resources.

Textbook activity

- Discuss the root driving forces behind desertification. Illustrate your answer with at least three examples.

Intensive grazing

Reading activity

Study the section "Intensive grazing" on pages 84–87 in Middleton.

Reading organiser

- Notice how frequently Middleton, in his discussion of overgrazing as a contributory cause of desertification, also refers to erosion.
- Soil degradation is a process and should not be considered in isolation.
- The term "piosphere" as an indicator of the localised impact of grazing on vegetation and soils.

Textbook activity

- Study figure 5.4 on page 86 in Middleton. Name the visible signs in the pasture that indicate that the veld has possibly been overgrazed.
- Why is this area referred to as a "pioshere"?
- Explain why a fixed carrying capacity for grazing has become an unpopular concept.
- Argue whether politicians should shoulder part of the blame for the deterioration in grazing areas.

Overcultivation

Reading activity

Study the section "Overcultivation" on pages 87–88 in Middleton. Note the references to the way in which certain practices lead to lowered outputs, erosion and eventually to desertification.

Reading organiser

- The agents of soil erosion in instances of overcultivation.
- Examples of where over-intensive agricultural practices took place.
- Negative impacts of overcultivation.

Textbook activity

- Point out the most common agents of soil erosion in cases of overcultivation.

- Name the three areas distinguished as examples of over-intensive agricultural practices (Middleton 2008:88).
- Use table 5.3 on page 88 in Middleton to summarise the negative impacts of each of the following practices in telegram style:
  - shorter recovery period
  - mechanisation
  - utilisation of marginal soil

Write a short paragraph to debate the following statement: "Gambling with the natural elements is a recipe for economic decline in the long term."

Overexploitation of vegetation

Reading activity

Study the section "Overexploitation of vegetation" on pages 88–90 in Middleton.

Reading organiser

- The main reasons for the destruction of natural vegetation.
- The collection of firewood can give rise to desertification.

Textbook activity

- What are the main reasons for the destruction of natural vegetation?
- Make a list of the countries and regions (not towns) highlighted in the prescribed section as examples of areas where the natural vegetation has been destroyed or is being overexploited.
- Indentify on the world map where these countries and regions are, and write the contributory cause/causes of the deforestation down on the map.
- Explain how the collection of firewood can give rise to desertification. Also point out the factors that have a spatio-temporal effect on the collection of fire-wood.

Salinisation

Reading activity

Study the section "Salinisation" on pages 90–93 in Middleton.

Reading organiser

- Countries in which the salinisation of irrigated areas is becoming critical.
- The association between these countries and the Aral Sea tragedy.
- The meaning of salinisation and the role of irrigation in salinisation.

Textbook activity

Table 5.6 on page 92 in Middleton pinpoints Turkmenistan and Uzbekistan as two countries in which the salinisation of irrigated areas is becoming critical. What is the association between these countries and the Aral Sea tragedy to which Middleton refers?

- Explain briefly what you understand by salinisation of soils, and explain how irrigation can lead to salinisation.

Understanding desertification

Reading activity

Study the section "Understanding desertification" on page 95 in Middleton.

Reading organiser

- The necessity of long-term monitoring of specific problem areas in order to find appropriate solutions to the problem of desertification.
- Where does desertification take place?
- How does desertification take place?
- Why does desertification take place?
- The distinction between those impacts that can be attributed to normal fluctuations in the natural environment (eg drought cycles) and those that have resulted from human activities.

Textbook activity

Read the case studies "The US great plains" and "The Sahel" on pages 96–98 in Middleton and then do the following activities:

- Explain why the Sahel region of North Africa was so severely stricken by wind erosion during the 1970s and 1980s. (Hint: Your answer should show that you understand the interaction between the various processes of soil degradation.)
- Discuss how the social, political and economic conditions in Nigeria contributed to the Sahel catastrophe of the 1970s.
- Compile a list of examples to show that the underlying contributory causes of soil degradation are socioeconomic, political and cultural forces. In each case, write down the name of the country, town or region, as well as the underlying contributory cause. Mark all the countries, towns or regions on the world map.
- How would you criticise the statement that there is a cause-effect relationship between desertification and famine?

Conclusion

Read the address below by Ryutaro Hashimoto, as it is a synopsis on the causes and problems of desertification.

Keynote address

delivered by Ryutaro Hashimoto, Honorary Spokesperson for the International Year of Desert and Desertification, Yayoi Hall, University of Tokyo, at the Public Forum "Combating Desertification and Agricultural Development", on 5 June 2006.

Drought and desertification are serious challenges even in the Asia region. More than one-third of the desertified areas in arable drylands are in Asia. However, how many Asian people know this reality and tackle this issue with a sense of urgency? We cannot change these threatening situations unless people other than those living in and facing the reality of serious drought and desertification learn how serious the situation is. It is estimated that 250 million people are directly affected by desertification in the world. And the majority of these people are poor. In order to achieve the "Millennium Development Goals" for halving the number of poor people with the daily income of less than 1 dollar by 2015, effective measures will need to be taken against desertification.

It is said that the causes of desertification are affected by various factors such as climate change. However, factors such as deforestation, over-grazing, over-cultivation, excessive irrigation and excessive agrochemical use also cause large impacts. It is important to establish a strategy and set a priority for combating desertification and mitigating drought impacts. For this purpose, it is essential to take actions aimed at long-term goals rather than myopic interests through forging consensus among governments, experts and affected people, and conducting thorough research. I am not an expert on this issue and not able to provide details, but it will take greater efforts and funding to restore degraded land than was required for the degradation processes to occur.

Each one of us will need to make an effort: that will be the only way to combat desertification on this planet. I would like to conclude by expressing the hope that we will leave behind a better global environment for our children and grandchildren (http://www.unccd.int/IYDD/documents/iydd/docs/Hashimotokeynoteaddress-note.pdf, accessed 12 June 2009, our editing)

Study Unit 6

Oceans and coastal problems

Did you know?

For birds to survive catastrophic oil spills like that of the Treasure, well-equipped bird-rescue crews must be mobilised quickly. Human handlers arrive with food and water.

Once the birds are stabilised, the cleaning process begins. The animals are placed in plastic tubs and, using a mixture of warm water and a dab of mild soap, rescue workers scrub the birds' feathers. For the eyes and ears, a water pick or toothbrush is used to avoid damaging sensitive organs.

Once scrubbed, the birds are rinsed with warm water, placed in cages with hair dryers, and – after they're dry – released into a pool of warm water.

When the birds regain their natural weight and blood values, they are released back into the wild. What happens next is, for most species, an open question. The technology to track wild birds is too invasive to deploy (news.nationalgeographic.com/.../0921_040921_oil_penguin_2.html, accessed 30 April 2009, our editing).

This is not whitewash...This is detergent!

Sources to consult

DVD clip 3

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Ocean pollution; mangroves

Atlas: World map on mangrove forests and coastal developments

Prescribed book: Chapter 6, "Oceans", on pages 100 (introduction) 111–116 and chapter 7, "Coastal problems", on pages 125–128. Certain parts in chapters 6 and 7 do not form part of the study material. Study only the parts referred to in this study unit.

Learning outcomes

After completing this study unit, you should be able to

- explain how the oceans are threatened by pollution
- name the main sources of marine pollution
- explain how coastal areas are affected by pollution
- explain how mangroves are affected by human activities
- explain the association between level of development and type of water pollution

Introduction

The oceans occupy 71% of the earth's surface, contain 97% of the water on earth, are the initial source of most of the water that occurs on land, play a fundamental role in the functioning of the earth's climate, supply people with food and other resources, and serve as a dumping site for waste products.

Since most of the pollutants that end up in the oceans are from land-based sources, the most serious impacts of this type of pollution frequently occur in coastal waters, particularly in parts alongside areas with high population and/or industrial concentrations.

Coastal habitats, in particular mangroves, salt marshes, sea grass beds and coral reefs, are being increasingly threatened by human activities. This threat manifests in direct destruction (eg for urban expansion), overutilisation of the resources that occur in these areas (eg abalone, crayfish, shellfish and kelp), pollution and erosion.

Pollution

Reading activity

Study the sections titled "Pollution" on pages 100, 111–116, and 125–128 in Middleton.

Reading organiser

- The sources of materials polluting coastal waters.
- Pollutants that break down easily over a period of days and those that can take centuries to break down.
- The threats that oil and petroleum spills pose to the coastal ecology.
- The threats that pollution by heavy metals and inorganic chloride compounds pose to the coastal waters and ecology.
- The various ways in which the oceans are polluted by oil.
- The role of shipping and air transport in polluting the open sea.
- The various international conventions on the dumping of waste in the ocean.
- The effectiveness, or otherwise, of these conventions.

Textbook activity

- What perceptions contribute to the pollution of the oceans?
- Who owns the oceans?
- How do ships contribute to water pollution? How often does this occur?
- Name an example of a shipping oil disaster that occurred close to the South African coast during the past 10 years.
- What happens to waste materials that are dumped into ocean waters?
- How are waste materials in the oceans regulated?
- Where do the raw materials polluting the coastal waters come from?
- In which parts of coastal waters could pollution have particularly serious consequences? Give reasons for your answer.
- Why might sea levels rise in coming decades, and what problems might these present to coastal environments?
- Distinguish between non-conservative and conservative marine pollutants.
- Describe the human activities that have increased the nutrient flow to coastal environments.
- What is the impact of coastal eutrophication?
- Describe the possible effect of global warming on coastal eutrophication.
- Discuss the effect of the longevity (life span) of certain pollutants in the ocean, in spite of being diluted by water.

Habitat destruction

Reading activity

Study the section "Mangroves" on pages 134–138 in Middleton.

Reading organiser

- What the mangroves consist of, where they occur and why their survival is important.
- The reasons why mangroves are being destroyed.
- Examples of the destruction of mangroves on a global scale.
- The importance to conserve mangroves.

Textbook activity

- Why are mangroves an endangered habitat along the coast of West Africa?
- Name an example of a region where mangroves have been destroyed by warfare related activities.
- Why is it important to conserve mangroves?

Conclusion

The following newspaper article from the Mail & Guardian, written by Julio Godoy, reiterates the fact that high nitrogen levels in oceans can become a major environmental issue.

"Ocean fertilisation" or extreme pollution?

Julio Godoy, Bonn, Germany

May 30 2008 16:05
When some multinational companies dump chemicals into the sea, they call it "ocean fertilisation". This practice is near the top of the agenda at the United Nations conference on biological diversity in Bonn that ends on Friday.

"Ocean fertilisation simply means dumping into the ocean particles of iron, nitrogen or urea allegedly to transform the ecological balance of particular marine habitats, to encourage additional phytoplankton growth, and increase absorption of carbon dioxide," says Saskia Richartz, ocean expert at Greenpeace.

Practically all developing countries want the UN conference to approve a global moratorium on ocean fertilisation until scientific evidence can prove that the practice does not bring new pollution risks. But some industrialised countries, led by Australia, want to avoid a strong ban.

Phytoplankton collectively account for half of the carbon dioxide absorbed annually from the Earth's atmosphere by plants. Through photosynthesis, plankton captures carbon and sunlight for growth, releasing oxygen into the atmosphere.

The supposedly scientific hypothesis behind ocean fertilisation is that dumping "nutrients" such as iron, nitrogen and urea into seawater would lead to growth of new phytoplankton that would absorb more carbon dioxide, thus reducing the main cause of global warming and climate change.

"The problem is, there is no sound scientific evidence that this would actually happen," Richartz says. "On the contrary, ocean fertilisation could have negative side effects that would lead to further loss of marine biodiversity."

Since 1978, 12 international projects have tried to prove the hypothesis of "ocean nourishment" with no success, says Silvia Ribeiro, an environmental researcher with the Canada-based Action Group on Erosion, Technology and Concentration (ETC).

According to ETC research, most of the additional carbon dioxide absorbed by phytoplankton appears to be released back into the environment when the plankton die, or are eaten by marine creatures.

Other risks include reduction of oxygen levels beneath the sea surface caused by the degradation of plankton, resulting in excess production of methane, another strong greenhouse gas responsible for global warming and climate change.

Ocean fertilisation could also modify marine ecosystems in uncontrollable ways by inducing changes in the food chain in localised marine biological habitats.

"One consequence of iron-induced blooms could be the consumption and depletion of other vital nutrients that would reduce plankton productivity and carbon absorption in other areas of the seas, with unknown effects in other ecosystems," Ribeiro says.

Yet another risk is the artificial growth of harmful algae, which produce toxins associated with the poisoning of fish and other sea life.

Richartz says that the debate at the UN conference has been controversial. "Brazilian delegates have been cooperating with Australia in order to avoid a moratorium on ocean fertilisation."

On May 26, the Brazilian delegation "presented an extreme unacceptable proposal on the moratorium, with the only ostensible objective of making the Australian position appear moderate", Richartz says.

But within hours, Brazil withdrew the proposal. "The debates within the Brazilian delegation were very loud", Richartz says. This was confirmed by Brazilian NGO representatives.

Ribeiro says that "what Australia wants on ocean fertilisation is obvious. It wants that the UN convention on biological diversity does not touch the subject, and transfer it instead to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter".

One reason for Australia to want that is that the UN convention would approve a global binding set of rules ratified by 191 countries, while the London convention has 88 parties.

In addition, the London convention is being updated through the London protocol, which will eventually replace the former. Under the new protocol, all dumping is prohibited except for acceptable waste on the "reserve list". But this protocol has been ratified by still fewer countries, 34.

The leading global company in the business is the Australia-based Ocean Nourishment Corporation (ONC). The Australian government's support for the company and for ocean fertilisation has won it the Greenpeace nomination for the Golden Chain Saw Award for the worst polluters.

The ONC is currently planning to dump hundreds of tonnes of industrially produced urea, most likely into the Sulu Sea between the Philippines and Borneo. The dumping of urea could imperil the local marine environment – the main source of livelihood for the poor fisher population in the Philippines.

Besides the ONC, a handful of private companies, all registered in the United States, are planning to launch ocean-fertilisation projects in unregulated high seas after specific projects in the Philippines, Ecuador, Oman and Morocco provoked a storm of complaints from civil society groups.

Environmentalists say the UN conference should approve a global moratorium and ban the granting of carbon credits for ocean carbon sequestration, tradable at the carbon-exchange mechanisms created by the Kyoto protocol on climate change. – IPS

(www.mg.co.za/article/2008-05-30-ocean-fertilisation-or-extreme-pollution).

Study Unit 7

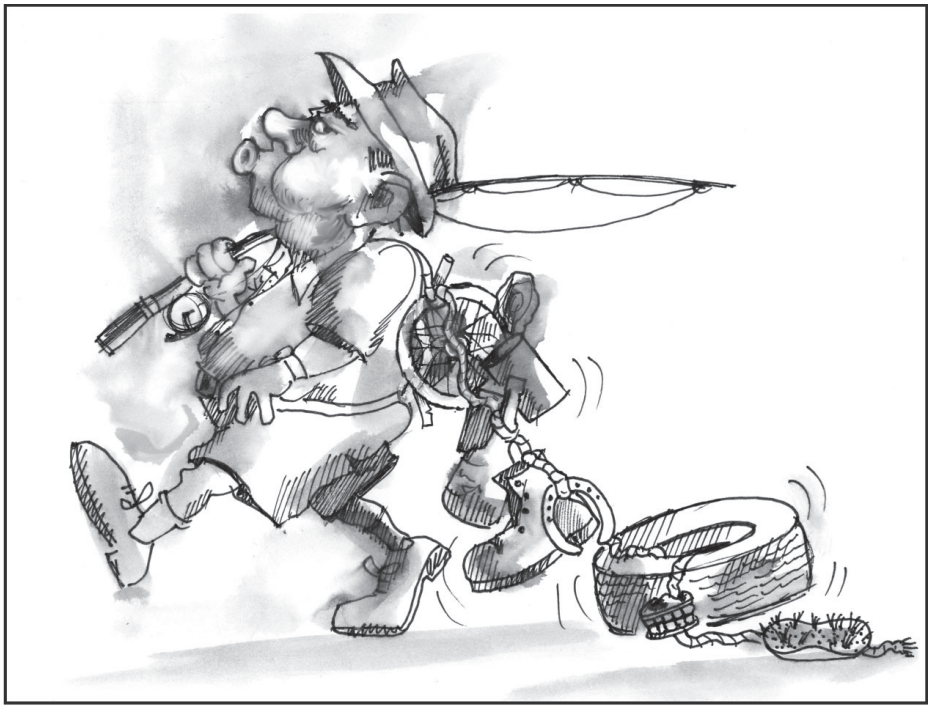
Rivers, lakes and wetlands

Did you know?

Historically wetlands have been seen as wastelands to be converted to alternative uses such as cropland, dams, and plantations of exotic trees, waste disposal sites and pastures. Many wetlands have been "reclaimed" for industry and the construction of airports, harbours and sewage treatment plants. Wetlands have been drained in attempts to control malaria.

All wetlands in southern Africa are threatened. Botswana's magnificent Okavango Delta is threatened by the possible canalization of the Boro River to supply water for both domestic and industrial use. In KwaZulu-Natal, debate rages over the mining of the dunes on the eastern shores of St. Lucia because of the unknown consequences to the water table in the area.

St. Lucia is a Ramsar recognised site. The Ramsar Convention on Wetlands of International Importance recognises such wetlands and works to conserve them. South Africa has 12 sites recognised by the Ramsar Convention, including Langebaan on the west coast, Barberspan in Gauteng and De Hoop vlei in the Cape (http://www.deltaenviro.org.za/resources/envirofacts/wetlands.htm, accessed 30 April 2009).



A Good day's catch

Sources to consult

DVD clip 6 (Rietvleidam)

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Wetlands

Atlas: World map on industrial countries and river pollution

Prescribed book: Chapter 8, "Rivers, lakes and wetlands", on pages 147–164 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- discuss the impact of human activities on rivers
- explain how the damage caused by pollution to rivers can be reversed
- name the different ways in which the flow patterns of rivers can be and have been altered by people
- discuss relevant considerations in the management of rivers
- explain how lakes are affected when the flow patterns of rivers are altered by people and give an example
- explain how the indigenous aquatic life of a lake is affected by the introduction of exotic species and give an example
- explain how eutrophication is accelerated by pollution and what the final outcome is for the aquatic life in lakes
- discuss the relevant considerations that are applicable in managing lakes
- explain what a wetland is and why it is of value to people and nature
- explain where and why wetlands are destroyed as a result of human activities
- explain what is being done and suggest what can be done to protect wetlands

Introduction

Rivers represent an important source of fresh water to people; however, water is seldom available in the places where it is required. In the high and low latitude regions of the world, there is usually a surplus of river water, while in large parts of the middle latitudes and the subtropics the demand for water exceeds the supply. In the subarid, subhumid and seasonally dry parts of developing countries, that are largely characterised by rising population numbers, the pressure placed on water supplied by rivers is among the highest in the world.

Rivers do not come under pressure only because their water is used by humans. The problem is that the utilisation of river water is also frequently accompanied by pollution through a number of sources.

Rivers are not affected by pollution only, but also by human activities which alter their patterns of flow. Examples of these include the channeling of rivers, the diversion of river channels and also the damming of rivers. Although people try to optimise their utilisation of rivers as a resource through these activities, injudicious attempts can have negative implications for the environment in the long term.

Although much of the fresh water that is used by people comes from rivers, rivers are not the only source of fresh water. In fact, more fresh water occurs collectively in all the lakes of the world than in all the rivers. As in rivers, the water in lakes is also affected by human activities, and this effect mostly manifests as deterioration in the quality of the water.

Pollution often has a much more serious impact on the water in lakes than it has on river water. The reason for this is that the water in lakes is often stagnant, so that pollutants are not diluted as effectively as in the case of rapidly flowing rivers. This makes lakes more sensitive than rivers to the harmful effects of pollution. Lakes are, however, not affected by pollution only, but also by changes in the flow patterns of the rivers that feed them. The withdrawal of large quantities of water from rivers for the purpose of irrigation can, for instance, result in much less water eventually flowing into lakes than was previously the case.

The prevention of damage to lakes is not only the best option in the long term, but also the cheapest, particularly if we take into account the costs to repair the damage already done or to halt it. This is easier said than done in practice, however, and there are numerous factors restricting the effective management and maintenance of lakes.

Regarding wetlands, numerous attempts are being made to conserve or restore them, thanks to a growing awareness of their importance over the past two decades.

Rivers

River pollution

Reading activity

Study the section “River pollution” on pages 147–150 in Middleton.

Reading organiser

- Six forms of water pollution.
- Consequences of the dumping of organic waste in water for aquatic life.
- Results of thermal pollution for aquatic life.
- Results of dumping inorganic waste in water.

- Spreading diseases through dumping sewage into water.
- The lack of data on water quality.
- Evolution of water pollution in industrialised countries over the past 100 years.
- The form that water pollution takes in industrialising countries.
- The sector of a society or community usually worst affected by water pollution.
- The reasons why water pollution problems cannot be resolved easily.
- The variation in the quality of river water between high, middle and low-income countries.
- Research findings concerning the main sources of pollution of rivers in the USA.
- Pollutants resulting from agricultural activities ending up in rivers.
- The link between rising nitrate levels (nitrate is a form of nitrogen) in river water and increased use of fertilisers.
- The way in which rivers in both rich and poor countries are polluted by sewage.
- Pollution of rivers in and around Manila, the capital city of the Philippines.
- Circumstances surrounding the pollution of the Vistula River in Poland.
- The role of economic and political factors in attempts to repair the damage caused by river pollution.
- Success achieved in the rehabilitation of rivers such as the Mississippi, the Rhine and the Thames.

Textbook activity

- Name three types of fluid organic waste that pollute water. Indicate the source of each of these types of waste.
- Explain how aquatic life is affected by organic waste.
- Name three examples of liquid inorganic waste.
- Which types of water pollution proved to be a serious problem during the Industrial Revolution?
- Which types of water pollution replaced this particular form of water pollution as the major threat to human existence on earth for the remainder of the 19th century?
- Name the worst harmful effects of water pollution.
- Name the pollutants that are dumped in rivers as a result of agricultural activities.
- What can the nitrate levels in rivers over the past few decades be attributed to, and what are the consequences thereof?
- What is the reason why the Vistula River in Poland has a bad name?
- Do you think that it is possible to reverse the damage that pollution causes to rivers? Substantiate your answer by referring to an example.

- Why do people alter the flow patterns of rivers? Name two examples of such types of changes.
- Why is it important for rivers to be ecologically healthy?

Lakes

Lacustrine degradation

Reading activity

Study the section "Lakes; lacustrine degradation" on pages 153–157 in Middleton.

Reading organiser

- The California examples of firstly Lake Owens, which has dried up completely, and secondly Lake Mono, which is drying up, both as a result of the diversion and withdrawal of water from the rivers feeding them.
- The circumstances surrounding the drying up of the Aral Sea in Central Asia, and the implications for both the people living there and the environment.
- Consequences of the introduction of exotic species (both fauna and flora).
- The impact of water pollution.
- Eutrophication in lakes and what the results are for aquatic life.

Textbook activity

- What were the ecological implications of the introduction of the exotic Nile perch (a type of fish) into Lake Victoria?
- What were the economic implications?
- What do you think should carry more weight in decisions about introducing exotic species into lakes: the ecological implications or the economic implications? Briefly substantiate your viewpoint.
- Which human activities can increase eutrophication in permanent bodies of water such as lakes and dams? How do these human activities affect aquatic life?

Lake management

Reading activity

Study the section "Lake management" on pages 157–158 in Middleton.

Reading organiser

- Experience gained in the management of the North American Great Lakes.

- Effective management of lakes requires the integration and reconciliation of political, economic and ecological factors.
- Importance of finding a balance between ecological interests and the interests of the users of lakes.
- The role of the public in the protection and management of lakes, for example in the case of Lake Baikal.

Textbook activity

- Name the various considerations that should play a role in the management of lakes.
- Explain the role of legislation in the conservation/management of lakes. Can lakes be protected/managed without legislation?

Wetlands

Wetland destruction

Reading activity

Study the introductory paragraphs of the sections on "Wetlands" and "Wetland destruction" on pages 158 and 162 in Middleton.

Reading organiser

- The various reasons why wetlands are of particular importance to both humans and the environment.
- The global extent of the destruction of wetlands.
- Parts of the world in which the destruction of wetlands is prevalent.
- Examples that illustrate the various causes of wetland degradation and destruction.

Textbook activity

- Name and briefly discuss at least one example of each of the following factors leading to the destruction of wetlands:
  - agriculture
  - disease prevention
  - mining
  - urban expansion
  - water utilisation
  - the exploitation of energy sources (eg collection of wood for fuel)
- Why do wetlands generally have a positive effect on the quality of water?

- What can be regarded as the main cause of the destruction of wetlands in the world?
- Which system of wetlands along the north coast of KwaZulu-Natal is being threatened by mining activities?
- What happened to the numerous wetlands in and around Mexico City? Why did this happen?

Wetland protection

Reading activity

Study the section "Wetland protection" on pages 162–164 in Middleton.

Reading organiser

- The Göksu Delta in Turkey as an example of the continual threats to a wetland despite its proclamation as a conservation area.
- The situation regarding the conservation of wetlands in the USA.
- International attempts to conserve wetlands, namely the Ramsar Convention.
- The degree of success of the Ramsar Convention.
- Problems concerning the conservation of wetlands in developing countries.

Textbook activity

- In which parts of the world does the collection of fuel wood pose a threat to wetlands?
- Which international convention has as its goal the protection of wetlands?

Conclusion

From wetland to wasteland: the destruction of Hamoun Oasis
by John Weier

For the past 5,000 years people have for the most part lived in harmony with the wetlands and their wildlife. An entire culture formed around the Hamoun with a way of life suited to the desert wetlands. They fashioned long reed boats to navigate the shallow waters and erected squat, red clay houses to withstand the heat of the desert. Their livelihood was based almost entirely on hunting, fishing, and farming. Not more than five years ago, the annual fish catch in the region topped 5,000 kilograms (12,000 pounds). Cattle, goat, and sheep ranchers tended over one million domesticated animals in the region. Farmers cultivated a wide range of fruits and vegetables around the Hamoun, including wheat, barley, millet, cotton, sugar cane, and even grapes and melons.

The combination of drought and massive irrigation projects proved to be too big of a shock to the wetlands. The local fish and bird populations all but disappeared.

Animals that could not sustain themselves in the desert or make the long journey to another oasis died. Winds that were once cooled by the waters of the wetlands now blew dust, sand, and salt from the lakebeds onto the surrounding villages. Up to 100 towns have been submerged by windblown dust thus far (Partow 2003). Most of the crops have been reduced to dustbowl conditions, hundreds of thousands of livestock have been lost, and every fishery has been closed.

Just as with the Aral Sea disaster, many who had lived around the Hamoun for generations either moved away or lost everything. At the same time, a huge influx of refugees from Afghanistan moved in. "Sistan has become a focal point for refugees from all over Afghanistan, hosting an estimated 320,000. So it is difficult to separate environmental refugees from the fleeing of the war," says Partow. The increase in people coupled with a severe drop in the quantity and quality of food resulted in increased risk of malnutrition, particularly among vulnerable groups like children and the elderly

(http://earthobservatory.nasa.gov/Features/hamoun/).

Study Unit 8

Big dams

Did you know?

A number of large dam projects in Africa have been funded by the European Investment Bank. An example is the 115 metre high Maguga Dam situated in Swaziland, which is the fifth highest dam in Southern Africa after the Katse and Mohale (Lesotho), the Kariba (Zimbabwe) and the Cabora Bassa (Mozambique). Construction began in 1998 and was completed in 2002. The 870 metre long reservoir has a storage capacity of 332 million square metres of water. The Maguga Dam affected some 125 homesteads by inundating either their arable land and/or their structures.

Another example is the Lesotho Highlands Water Project, which includes five dams, 200 kilometres of tunnels blasted through the Maluti Mountains, and a 72 MW hydropower plant. It is one of Africa's largest infrastructure projects. The project's primary purpose is to transfer water to South Africa's industrial heartland. Two dams and the hydropower component were completed at a cost of approximately US$ 3.5 billion

(http://bankwatch.org/documents/raising_the_bar.pdf, accessed 30 April 2009, our editing).

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Big dams

Atlas: World map: big dams

Prescribed book: Chapter 9, "Big dams", on pages 169–185 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- discuss the various environmental impacts that are associated with big dam walls and their reservoirs
- demonstrate and explain by means of examples the effects the construction of a big dam has on upstream and downstream areas
- evaluate the political impacts of big dams

Introduction

People have been building dams for at least the past 5 000 years of humankind's existence on earth, to enable them to make optimal use of water resources. The first dams were built to control floods and also to provide water for irrigation and for domestic consumption. At a later stage, additional functions such as storing water over long periods, generating hydroelectric power and regulating river flow were added to the list.

The modern era of large dams dates back to the 1930s, and was heralded by the construction of the 221 metre high wall of the Hoover Dam on the Colorado River in the USA. Over the past 40 years there has been a marked increase in the rate at which large dams have been constructed all over the world, and in their scale. While a total of 7 408 large dams all over the world had been registered by the International Commission on Large Dams by 1960, this number had increased to 36 562 by 1986. Although most of the new large dams have been built in the 112 temperate latitudes, countries in the tropics and in the subtropics (such as Brazil, Mexico, India, Nigeria and Venezuela) are also beginning to build large dams.

It is estimated that the total river runoff that is regulated globally by large dams increased from 10% in the 1970s to 13,5% in the early 1990s. The present figure is probably in the region of 15%. There is no doubt that these large dams have numerous advantages, and that dam building projects are also frequently highly successful. Large dams make it possible to generate hydroelectric power and to manage and regulate river runoff, and they also offer protection against droughts and floods. Although socioeconomic objectives have been achieved through the

construction of many large dams, both the construction work and the reservoirs themselves are often associated with negative impacts on the environment. These negative impacts have made the construction of new dams a highly controversial issue that attracts worldwide attention.

Environmental impacts of big dams

Reading activity

Study the section "Environmental impacts of big dams" on pages 169–180 in Middleton. Note that Middleton divides the impacts of dams into three categories:

- the dam wall and its reservoir (pp 169–175)
- the upstream area (pp 175)
- the downstream area (pp 176–80)

Reading organiser

The dam and its reservoir

- Loss of vegetation, animal life and other resources in the area that is flooded.
- Change in the water quality that occurs when river water is dammed.
- Consequences of damming and the flooding of areas for people's health.
- The accumulation of sediments in the reservoir.
- The way in which the groundwater level is affected.
- Possible consequences for local climatic conditions.
- Possible resettlement of people and the associated problems.

The upstream area

- The example of Wadi Allaqi in Egypt.

The downstream area

- A dam wall as an obstruction interrupting the flow of the river.
- Dams bring about a total change in the hydrological system of the river.
- There are several consequences for the water quality:
  - The volume and speed of the water are influenced.
  - The sediment load carried by the river changes.
  - There are negative consequences concerning plant and animal life.

Textbook activity

- Study the graphs in figure 9.5 on page 177 in Middleton and answer the following questions:

- What trend did the average annual sediment concentration in the three rivers respectively show from 1960 to 1980?
- Explain the reason for this phenomenon.
- Describe a possible impact of these dams on the downstream areas.

- What is lost when a dam is constructed and the land is flooded?
- What happens to the quality of the water during the first few years of a dam's existence? Give reasons for your answer.
- What happens to the people living in the area where a dam is built?
- Name the disease, which spreads less easily because of large dams, and one example of a disease, which spreads rapidly due to the presence of large dams.
- How do big dams affect the transportation of sediment by rivers? What are the economic implications?
- Name the impacts of large dams on the groundwater level in its vicinity.
- What is the impact of a large dam on the area upstream?

Political impacts of big dams

Reading activity

Study the section "Political impacts of big dams" on pages 180–185 in Middleton.

Reading organiser

- Gaining the acceptance of the affected people.
- Comprehensive environmental assessments to mitigate environmental impacts.
- Scientific information about ecosystems, social and health issues should be gathered and analysed, taking into account the cumulative impacts of dams and other development projects on ecosystems.
- "Sharing for peace" ensures that projects do not worsen local or regional tensions over the use of rivers.
- Sustaining rivers and livelihoods should be the goal in the planning phase of the construction of a big dam.
- The European Investment Bank has been involved in a number of large dam projects in recent years, many of them in Africa.

Textbook activity

- Debate the following statement by Lori Pottinger:

  The European Investment Bank has in recent years funded large dams in poor countries that have led to forcible resettlement for tens of thousands of poor rural farmers and fishers, pushed rare species into extinction, and irrevocably changed rivers around the world. There are better ways to help poor nations

get water and electricity. It's time for the EIB to adopt better practices on large dams (http://www.bankwatch.org).

Conclusion

We conclude this study unit with a case study on Maguga Dam in Swaziland, as it illustrates the environmental and social impacts of a big dam.

Case study

Report compiled by the Komati Basin Water Authority (KOBWA). The main aim of the Maguga Reservoir in the Komati River is to supply irrigation water to downstream farmers in both Swaziland and South Africa. The construction and inundation have had critical environmental impacts. These impacts can be grouped into two broad categories, namely environmental and social.

Environmental impacts

Impact on vegetation

The vegetation surrounding the reservoir comprises of different habitats, namely forests, thicket, closed grasslands, as well as closed and open woodlands. In total, 643 indigenous plant species have been recorded in the Maguga am basin. These represent about 20% of Swaziland's known flora. The reservoir resulted in the loss of plant species used for timber. In total about 77 000 m^3 of timber was lost due to flooding. Of this 800 m^3 is kiaat, that is used for furniture and carving.

Aside from these plant species, other plant species threatened by the reservoir were of medicinal value. The local residents therefore consulted herbalists on the medicinal plants found in the area, and these were translocated and propagated in a community-owned nursery.

Impact on birds

The environmental impact assessment (EIA) indicated that a total of 195 species of birds were found in the area to be submerged by the reservoir. The species composition varied according to habitat – 44% were woodland species, 20% grassland species, 17% forest species and 12% wetland species. Of these, 86% are present throughout the year. A total of thirteen (13) bird species are endemic to Swaziland, Lesotho and South Africa, and nine (9) of these species have red data status for the aforementioned countries.

Impact on mammals

About forty six (46) mammal species were identified in the inundation zone, compared to the total of fifty two (52) species found in the whole of Swaziland. One species, the woodland mouse, had never been found in Swaziland. A further eight

(8) others had never been recorded before in the Middleveld of Swaziland, and three (3) of these had been listed as "practically extinct outside reserves". They are the Cape hydrax, grey duiker and the grey rhebuck.

Impact on reptiles and amphibians

The Maguga environmental impact assessment (EIA) indicated that thirty four (34) reptile species and twelve (12) amphibian species were resident in the area to be inundated. Reptiles such as crocodiles, snakes and lizards such as the chameleon, are feared by residents. This fear and the accompanying threat to these species are compounded by beliefs and superstitions that result in them being used by traditional healers. Of all the reptile species found at Maguga, the Swazi thick-tailed rock gecko and the Barberton girdled lizard are of significant conservation value. These species had to be caught and released in suitable habitats outside the inundation area.

Impact on fish

The fish community of the Komati River is dominated by species adapted to flowing water conditions.

In total twenty two (22) fish species were recorded at Maguga, and two (2) of these species would be critically threatened by the creation of the reservoir. These were the Phongolo rock catlet (*Chiloglanis emarginatus*) and the Incomati rock catlet (*Chiloglanis bifurcus*). The construction of the dam would also create a major obstacle to the movement of migratory fish species such as eels. With respect to the above-mentioned fish species, the impact of the dam was regarded as minimal, as the species were found in other reaches of the river. The environmental impact assessment (EIA) and mitigation plan specified methods to mitigate the impacts of the reservoir on fish species.

Impact on aquatic invertebrate communities

Environmental studies indicated that the creation of the reservoir would alter the temperature of the river. This would impact on the aquatic invertebrate communities (such as bilharzia's vector snails, mosquitoes and blackfly), which would result in an increase in their population. The studies therefore proposed methods to both monitor and control these invertebrate communities.

Social impacts

Impact on archaeological sites

Archaeological visibility in the area inundated was high. A total of twenty (20) archaeological sites were recorded, ranging from sites from the Early Stone Age to sites from the Iron Age. In addition to these sites, a total of 184 graves were also identified. Given the religious, cultural and traditional practices associated with graves in Swaziland, all these graves had to be exhumed and relocated outside the area to be inundated. Secondly, the construction and inundation of the Maguga

Dam impacted on one rock painting site. The rock art/painting was successfully removed, and is currently stored at the national museum in Swaziland.

Impact on community health

Large construction projects such as the Maguga Dam attract large numbers of people seeking employment. These job-seekers are generally males who leave their partners behind in search of employment. They often find new sexual partners in the job area, and this contributes significantly to the spread of STIs/HIV/AIDS. The project therefore put together various ways to curb the spread of STIs/HIV/AIDS.

The professional staff of the consultant and contractor could bring their spouses/partners with them. It was believed that this would help integrate the staff with the residents of Piggs Peak.

Secondly, the project committed itself to not housing general labourers, but rather to sourcing them from the neighbouring communities. In this way, employees would sleep at home and only travel to work. This was intended to reduce the chances of employees engaging in new liaisons whilst away from home.

Thirdly, a trauma unit manned by a professional medical consultant was set up on site. This trauma unit provided health services to workers, their relatives and the general public.

The treatment of sexually transmitted diseases and HIV/AIDS counselling was a priority at the clinic. Furthermore the Family Life Association of Swaziland (FLAS) was contracted to provide HIV/AIDS education and information to the work force. A properly constituted, well-equipped and well trained Health Intervention Team (HIT) was set up within KOBWA to work with the Hhohho Regional Aids program to educate and counsel people in the project area on STIs/HIV/AIDS. This health intervention team was later absorbed by the ministry of health, and currently provides training and counselling on HIV/AIDS at the Piggs Peak government hospital.

Lastly, to minimise the long-term impacts of the project on community health, the project constructed two clinics within the project area. The clinics were handed over to the government of Swaziland for operation and maintenance. The clinics are operational and serve areas even beyond the project area (www.kobwa.co.za, accessed on 24 April 2009, our editing).

Study Unit 9

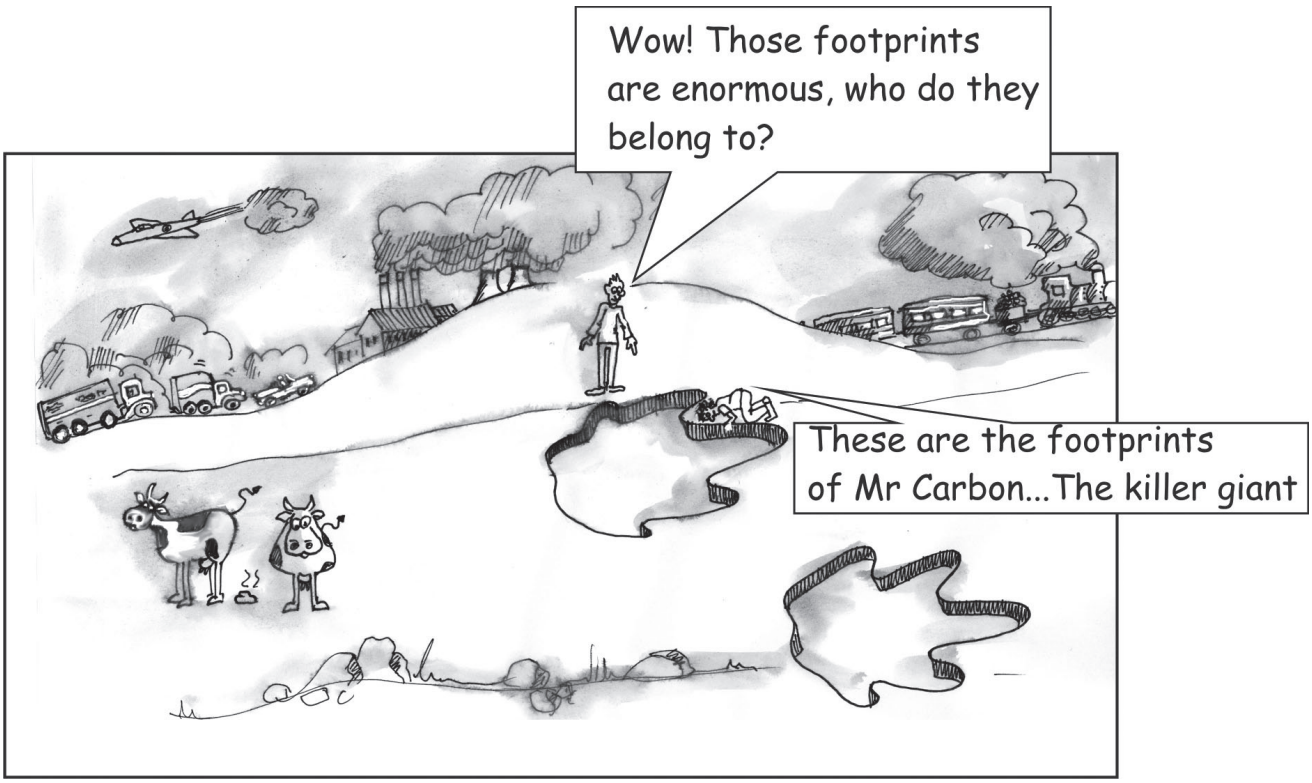
Climatic change

Did you know?

In November 2007, New Zealand's National Institute of Water and Atmospheric Research (NIWA) announced that ice volume in the country's Southern Alps had shrunk nearly 11% over the previous 30 years. NIWA scientists attributed the glacial retreat primarily to global warming and stated that, in the absence of substantial climate cooling, 12 of the largest glaciers would not recover to their previous sizes.

Tasman glacier, on New Zealand's South island, is the nation's longest glacier.

(http://earthobservatory.nasa.gov/iotd/view.php?id=8434, accessed 30 April 2009).



Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Global warming

Atlas: World map on the impact of global warming

Prescribed book: Chapter 11, "Climatic change", on pages 210–233 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- describe the various human activities affecting the atmosphere
- name the greenhouse gases and explain the greenhouse effect
- explain why the increasing concentrations of greenhouse gases in the atmosphere could lead to global warming
- describe the rising trend in atmospheric temperatures over the past 100 years
- explain how forecasts can be made about the impact of global warming on humankind and the environment
- discuss the possible impacts of global warming
- discuss the steps that are being taken on a global scale to combat global warming

Introduction

The climatic conditions on earth today are different from those of 1 000 years ago. Similarly, the climatic conditions of 1 000 years ago were different from those of 10 000 years ago. Thus the earth's climate has always been (and still is) subject to change. These changes are linked to natural causes such as variations in the earth's orbit around the sun.

It is generally accepted that the last glacial period reached its maximum intensity approximately 18 000 years ago, and that since then, the earth's climate has gradually warmed up. Since approximately 200 years ago, and particularly since the Industrial Revolution, a new role player has taken the lead on the stage of climatic change: humankind.

We know that various human activities affect the atmosphere in some way or another. People do not deliberately set out to change the atmosphere and the climate; their impacts should rather be seen as a result of the size of the human population and the extent of the associated human activities in the world today.

Past climatic change

Reading activity

Study the section "Past climatic change" on pages 210–212 in Middleton.

Reading organiser

- The occurrence of various relatively hotter and colder periods in the earth's history.
- What glacial periods and interglacial periods are.
- How information about the history of the earth's climate is obtained.
- How climatic change is explained in terms of variations in the amount of solar energy received by the earth.
- The reasons Milankovitch gives for the occurrence of glacial periods and interglacial periods.
- The ways in which temperatures have varied over the past 1 000 years, 20 000 years and 1 000 000 years respectively.

Textbook activity

- Describe the long-term variations in the earth's orbit that can lead to climatic change.
- How can we obtain information about climatic changes that took place a long time ago?
- What happens to temperatures during glacial and interglacial periods?
- Describe the outstanding characteristics of the global temperature pattern over the past 18 000 years.

Human impacts on the atmosphere

Reading activity

Study the section "Human impacts on the atmosphere" on pages 212–214 in Middleton.

Reading organiser

- The unintentional nature of the changes brought about by human activities in the atmosphere and in climatic conditions.
- Examples of various human activities affecting the atmosphere and the climate.
- The role of the ozone layer in the climatic conditions experienced on earth, and the way in which this layer is affected by human activities.

- The way in which changes to the land surface lead to changes in the albedo, and how these in turn influence the climate.
- How changes to the hydrological environment can influence the climate.
- How the climate can be affected by humans on a microscale (ie in your immediate surroundings), a mesoscale (ie in your region) and on global scale.

Textbook activity

- Name a few human activities associated with changes in the composition of the atmosphere.
- What does CFC stand for?
- Where does the ozone layer occur, and what does it consist of?
- Which important functions are performed by the ozone layer?
- How is the ozone layer affected by human activities?
- Explain how deforestation can affect climatic conditions.
- Name some of the activities you participate in daily that might have some effect on the atmosphere and climatic conditions.
- Give an example of how people can modify the local (micro) climate.

Greenhouse trace gases

Reading activity

Study the section "Greenhouse trace gases" on pages 214–217 in Middleton.

Reading organiser

- Main natural greenhouse gases that contribute to the heating of the atmosphere.
- Natural and human (anthropogenic) sources/origins of greenhouse gas pollutants.
- Trends in their release into the atmosphere.
- The relatively large heating potential of CFCs.
- Heating of the atmosphere under natural conditions.
- The lifetime of gases in the atmosphere.
- Consequence for the earth if these gases were not present.
- Mechanisms by which the atmosphere heats up.
- Rate at which these gases have been increasing since pre-industrial times.
- Relative contribution of each of these gases to the heating of the atmosphere.
- Cement manufacturing and deforestation as the main anthropogenic (human) sources.

- Long-term trends in both the emission and the atmospheric concentration of carbon dioxide.
- Variations in the amount of carbon dioxide on a global scale.
- Role of industrialisation and food production.
- Role of anthropogenic sources as opposed to natural sources.
- CFCs and other hydrocarbons are not from natural origins, but are exclusively caused by human activities.
- Covariation between temperature and the carbon dioxide content of the atmosphere during the geological history of the earth.

Textbook activity

- Name the main greenhouse gases.
- How did these gases land up in the atmosphere?
- Are they natural constituents (ingredients) of the atmosphere?
- Do they result exclusively from air pollution caused by people, or are they the result of a combination of natural elements and air pollution?
- How would it be on earth if there were no greenhouse gases in the atmosphere?
- Briefly explain how the heating of the atmosphere takes place under natural conditions.
- Explain how air pollution can lead to a rise in temperature of the atmosphere.

Global warming

Reading activity

Study the section "Global warming" on pages 217–219 in Middleton.

Reading organiser

- How present global temperatures compare with temperatures over the past millennium.
- The size of the observed rise in global temperature over the past millennium.
- Reason(s) given for this temperature increase.
- Discrepancies in the rising global temperature trend.
- Spatial variation in the rising temperature trend throughout the world.

Textbook activity

- What evidence is there to demonstrate the connection between the carbon dioxide content of the atmosphere and temperature conditions over the past millennium?
- When was the rising trend in temperature over the past 100 years interrupted?

- What has the temperature increase over the past 100 years been?
- Has this rise in temperature been uniform throughout the world, or has it varied from place to place?

Predicting impacts

Reading activity

Study the section "Predicting impacts" on pages 219–220 in Middleton.

Reading organiser

- Limitations of general circulation models.
- How forecasts are handicapped by a lack of knowledge.
- How forecasts are handicapped by the complexity of the climatic system.
- Problems involved in making provision for feedback loops in general circulation models.
- How the observed temperature increase over the past 100 years compares with the temperature increase forecasted by means of the general circulation models.

Textbook activity

- What aid(s) do we have for making forecasts about the climate?
- Name the three limitations of general circulation models.
- Name one example of a feedback loop that affects climate. Briefly explain how it works.
- By how much does the actual rise in temperature since 1880 differ from that forecast by means of general circulation models? Why do you think these figures differ?
- Do you think that we should be concerned about the temperature increases forecast by means of general circulation models? Briefly substantiate your viewpoint.

The impacts

Reading activity

Study the section "The impacts" on pages 220–229 in Middleton.

Reading organiser

- Spatial variation in the intensity of expected impacts in different parts of the world, and particularly in how people's way of life may be affected.
- The impact on:
  - ecosystems and habitats

- agriculture and food production
- rainfall and the availability of water
- high latitudes
- geomorphologic processes
- a rise in sea level

Textbook activity

- Explain how food production may be both positively and negatively influenced by global warming.
- Briefly explain how the availability of water in different parts of the world may be influenced by global warming.
- Explain why global warming is expected to lead to a rise in sea level. By how much is the sea level expected to rise? How might people be affected by changes in sea level?
- How will global warming affect arid regions?
- Why will not all places on earth be affected to the same extent by global warming?
- Which parts of the world would be most seriously affected by global warming? Briefly mention how these regions would be affected.

Responses to global climate change

Reading activity

Study the section "Responses to global climate change" on pages 229–233 in Middleton.

Reading organiser

- Debate between developed and developing countries as to who should take the greater responsibility for combating global warming.
- The contents of each of the following international agreements: the Montreal Protocol, the UN Framework Convention on Climate Change, and the Kyoto Protocol.
- Examples of the "no-regrets" initiatives to counteract global warming.
- The general belief that economic growth is inextricably bound up with an increase in energy consumption.
- Two future scenarios of the emission of carbon dioxide based on the global demand for energy.
- Deductions that can be made from these future scenarios.

Textbook activity

- Who, in your opinion, should take responsibility for combating global warming: the developed countries or the developing countries, or both? Substantiate your answer.

- Give an example of the "no-regrets" initiatives to counteract global warming.
- Discuss two future scenarios on how to scale down on carbon dioxide emissions.

Conclusion

You now know that the global temperature over the past 100 years has risen by approximately 0,68 °C. This might seem to you to be a very small increase, and you may be thinking "So what?" The truth of the matter is that the observed rise in temperature is in line with forecasted temperature increases based on the increase in the concentrations of greenhouse gases in the atmosphere over the same period. Research shows that an increase in the concentrations of all the greenhouse gases, which would be equivalent to twice that of the pre-industrial concentration of carbon dioxide, can be expected by the year 2050.

Based on the present trend of rising temperatures and the covariation between the concentration of carbon dioxide and temperature, it has been forecasted that by the year 2050, temperatures may increase by between 1,5 and 4,58 °C. Even a layperson should realise that a temperature increase of this size will have a significant impact on humankind and the environment. However, we need to ask ourselves how accurate these forecasts are and whether we should really concern ourselves with such issues.

Since the atmosphere and climatic conditions are closely connected with the functioning of the biosphere (plants and animals), pedosphere (soils), lithosphere (the earth's crust) and hydrosphere (water), the projected atmospheric and climatic changes will probably have significant repercussions for all aspects of the world we live in. The potential for such changes to disrupt settlement patterns, health conditions, political systems, and socioeconomic systems is equally great.

If we accept that global warming is a very real threat to people and the environment, there would be two approaches to trying to solve the problem and/or prevent the situation from deteriorating even further. The first approach would be to cut down on the emission of pollutants and thus combat anthropogenic climatic change (ie climatic change resulting from human causes). The second approach would be to accept that climatic change is unavoidable and to plan how to adapt to it. Both of these approaches to the problem of global warming would depend on the availability of adequate and accurate information, knowledge about the atmosphere and the functioning of the climatic system, and the interaction of the climatic system with the rest of the environment. Both approaches also presuppose that worldwide cooperation among all countries would be essential in order to make any progress towards finding solutions to the problem of global warming.

Study Unit 10

Acid rain

Did you know?

Production of ozone-destroying chlorofluorocarbons (CFCs) has stopped due to international participation in the Montreal Protocol treaty, but scientists do not expect to see the hole in the ozone significantly shrink for about another decade .... This lag is due to the long lifetimes (40–100 years) of CFCs already in the atmosphere. Full recovery is expected by about 2070. However, even that prediction is tentative, ... because scientists remain uncertain about how a changing climate will come into play. Because intense cold exacerbates the ozone hole, it is possible that warming over the South Pole could speed up recovery

(http://earthobservatory.nasa.gov/IOTD/view.php?id=8152, accessed 30 April 2009).

You won't get far...Eh,eh! My acid will get you.
I have the wind behind me.

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Acid rain
- **Go to**: The global distribution pattern of the acid rain problem

Atlas: World map

Prescribed book: Chapter 12, "Acid rain", on pages 236–254 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- explain what acid rain is and how it originates
- explain in which parts of the world acid rain occurs
- briefly discuss the impact of acid rain on the environment
- briefly discuss the steps being taken to combat acid rain

Introduction

Acid rain, which a Scottish chemist described as far back as 1852, is widely regarded as one of the most critical problems of the industrialised world. What people have taken centuries to build up, and what has come into being through centuries of natural evolution, can be degraded, ravaged and/or destroyed by acid rain within a few years.

Acid rain is associated with the emission of sulphur and nitrogen during the burning of fossil fuels such as coal and oil in power stations, industrial steam boilers or generators, and motor vehicle engines. When these pollutants come into contact with water vapour, oxygen and sunlight in the atmosphere, a diluted mixture of sulphuric and nitric acid is formed. In highly industrialised regions, hydrogen chloride also forms part of this acid mixture.

When this acid mixture is washed out of the atmosphere (eg when rain falls), or drops to the earth's surface in the form of particulates, it ends up in rivers and lakes, affects soils and plants, and even has an effect on human-made structures. The impacts are largely negative. The acid level in rivers and lakes increases, which affects aquatic life negatively. Vegetation is also damaged through the effects of acid precipitation.

The effects of acid rain are not confined to areas where the pollutants from which it is derived are released. Surrounding areas and even areas that are far from the source areas of pollution are affected. The strong winds that occur in the higher levels of the atmosphere play an important role in this respect. The fact that the pol-

lutants are often emitted from high chimney stacks into wind currents in the higher levels of the atmosphere adds to the problem. Besides the nature, extent and spatial distribution of the acid rain problem, it is also important for you to know what the consequences of acid rain are for people and the environment.

The best approach to adopt in combating and/or controlling acid rain is that prevention is better than cure. According to this approach, the most obvious strategy for combating acid rain would be to reduce the pollutant emissions that cause acid rain. A large number of methods could be used to achieve this objective; however, some are considerably more expensive than others. The socioeconomic and political situations in some countries make it very difficult to reduce pollutant emissions in practice. Due to the fact that pollutants that are released into the atmosphere cannot be contained within city, provincial or political boundaries, there are many complications in controlling acid rain.

It is important to realise that combating and control measures do not necessarily result in immediate improvements and the recovery of the environment. In fact, such beneficial results could be delayed by other environmental influences.

The impacts of acid rain have no benefit for either humans or the environment. In some cases, permanent or irreversible damage is done to the environment. It could be very expensive to repair such damage.

The nature of acid rain

Reading activity

Study the introductory paragraphs of chapter 12 and the section "The nature of acid rain" on pages 236–237 in Middleton.

Reading organiser

- The historical background to the problem of acid rain.
- The confusion surrounding the term "acid rain".
- The difference between the wet and dry deposition of acid.
- What the pH scale is.
- Natural factors influencing the acid content of the atmosphere.
- The anthropogenic (human) sources of air pollution leading to acid rain.
- The major sources of the type of air pollution leading to acid rain.

Textbook activity

- Which factors contribute to the occurrence of acid rain?

Geography of acid deposition

Reading activity

Study the section "Geography of acid deposition" on pages 237–240 in Middleton.

Reading organiser

- Uneven distribution of acid rain across the earth's surface.
- The magnitude of the anthropogenic (human) contribution to the acid content of the atmosphere equals the natural contribution at present.
- Those parts of the world where the acid rain problem is most serious.
- The shift in both the source areas of pollutants and the deposition pattern of acid rain in Europe over the past 100 years.
- The numerous acid rain "hotspots'' that are developing all over the world.
- Trends in the emission of pollutants giving rise to acid rain.
- The distribution of the acid rain problem cannot be contained within political borders.
- Pollutants giving rise to acid rain are often carried across great distances in the atmosphere, with the result that they eventually affect areas far from their initial emission points.
- The role of high chimney stacks in the distribution of air pollutants leading to acid rain.

Textbook activity

- Why is the acid rain problem not distributed evenly across the world?
- Name the parts of the world where the problem of acid rain is becoming serious.

Effects of acid rain

Reading activity

Study the section "Effects of acid rain" on pages 240–243 in Middleton.

Reading organiser

- Certain soils naturally have a relatively high acid content.
- The ability of ecosystems to neutralise incoming acid up to a specific critical stage.
- The meaning of the following terms regarding the effects of acid rain on ecosystems:
- buffering capacity

- critical load
- threshold

- The acid content of soil and water can also be affected by human activities other than those that cause acid rain.
- The negative consequences of acid rain.
- The impact on water environments such as lakes and rivers.
- The impact on plants and animals that live in water.

Textbook activity

- Explain the meaning of the following terms regarding the effects of acid rain on ecosystems:
  - buffering capacity
  - critical load
  - threshold

Aquatic ecosystems

Reading activity

Study the section "Aquatic ecosystems" on pages 243–245 in Middleton.

Reading organiser

- Tolerance of fish for water with higher than normal acid levels varies from species to species.
- Fish species gradually decline as their ability to reproduce is affected.
- The effects of the acidification of water on species other than fish and on vegetation.

Textbook activity

- Discuss the consequences of acid rain on water.

Terrestrial ecosystems

Reading activity

Study the section "Terrestrial ecosystems" on pages 245–248 in Middleton.

Reading organiser

- Five ways in which vegetation can be affected by acid rain.
- Loss of lichens and mosses as a result of acid rain in many of the industrialised regions of Europe.

- Various factors that could be responsible for the deterioration of forests.
- Symptoms shown by trees that have been damaged by acid rain.
- Recent examples of and reasons for the deterioration of forests in Europe.

Textbook activity

- Discuss the consequences of acid rain on plants.

Human health

Reading activity

Study the section "Human health" on page 248 in Middleton.

Reading organiser

- The impact of acid rain on the human respiratory and cardiovascular systems.
- Consequences of drinking water polluted by acid rain.

Textbook activity

- Discuss the consequences of acid rain on human health.

Materials

Reading activity

Study the section "Materials" on pages 248–249 in Middleton.

Reading organiser

- Accelerated corrosion of metals as a result of acid rain.
- Accelerated erosion of the brick or stonework of buildings as a result of acid rain.
- The rate at which metals deteriorate as a result of acid rain.
- Well-known buildings/monuments/statues in the world that have been damaged by acid rain.
- Effects of acid rain on material, paper and glass.

Textbook activity

- Illustrate the corrosive effects of acid rain on any monument, citing examples.

Combating the effects of acid rain

Reading activity

Study the sections "Combating the effects of acid rain", "Political aspects of emissions reduction" and "Environmental recovery" on pages 249–254 in Middleton.

Reading organiser

- Technology that could reduce the emission of pollutants that cause acid rain.
- Governments are hesitant to initiate expensive anti-acid rain programmes.
- The need for an integrated team approach by all the countries in a region.
- Combating and control measures focused on the major emitters of pollutants.
- Targets for the reduction of emissions of sulphur that European countries have pledged to strive towards.
- Countries notorious for releasing large quantities of sulphur dioxide and nitrogen oxides into the atmosphere.
- Trends in the release of sulphur dioxide and nitrogen oxides in the above-mentioned countries.
- Countries where emissions of these pollutants are increasing.

Textbook activity

- Name three technologies that could be used to try to limit emissions of industrial pollutants causing acid rain.
- In which two countries did emissions of both sulphur dioxide and nitrogen oxides increase sharply between 1980 and 1990? To what can this trend be attributed?
- Why did emissions of nitrogen oxides either remain practically constant or increase during the period 1980–1990?
- How long could it take for lakes to recover from the damaging effects of acid rain?

Conclusion

Ocean acidification could have broad effects on marine ecosystems

Science Daily (Dec 18, 2008) – Concern about increasing ocean acidification has often focused on its potential effects on coral reefs, but broader disruptions of biological processes in the oceans may be more significant, according to Donald Potts, a professor of ecology and evolutionary biology at the University of California, Santa Cruz, and an expert in coral reef ecology and marine biodiversity.

Potts will give an invited talk on "Geobiological Responses to Ocean Acidification" at the Fall Meeting of the American Geophysical Union (AGU) in San Francisco on Wednesday, December 17.

Ocean acidification is one of the side-effects of the rising concentration of carbon dioxide in Earth's atmosphere due to the burning of fossil fuels. The oceans can absorb enormous amounts of carbon dioxide from the atmosphere, but as the gas dissolves it makes the water more acidic. Increasing acidity can make life difficult for corals and other marine organisms that build shells and skeletons out of calcium carbonate.

Scientists fear that acidification will slow the growth of these organisms and cause calcium carbonate structures to dissolve. Potts agrees that dissolving shells will certainly be a problem for many marine organisms, but he thinks the disruptions will run much deeper.

"It's not just a question of coral reefs, and it's not just a question of calcification," he said. "What we are potentially looking at are disruptions of developmental processes and of populations and communities on many scales."

The term "acidification" refers to a slight lowering of the pH of ocean water, pushing it closer to the acidic end of the scale, although it is still slightly alkaline. A small decrease in pH affects the chemical equilibrium of ocean water, reducing the availability of carbonate ions needed by a wide range of organisms to build and maintain structures of calcium carbonate.

Many phytoplankton – microscopic algae that form the base of the marine food web – build calcium carbonate shells to protect themselves from microscopic predators called ciliate protozoa. A disruption of the ability of phytoplankton to build their shells could have ripple effects throughout the marine food web, Potts said.

"It's going to change the dominant organism in the food chain, and there's a very real danger that it may short-circuit the food chains," he said. In other words, ciliate protozoa gorging on unprotected phytoplankton may flourish at the expense of other organisms higher up the food chain.

"But calcification of shells is not the only biological process affected by acidification," Potts added. "All biochemical physiological reactions are potentially going to change," he said. Developing organisms are most likely to be affected, due to their low range of environmental tolerances, but it is unclear what the ecological ramifications will be.

Ocean acidification may not affect all parts of the oceans equally. Within 100 kilometres (62 miles) of shore, the pH of ocean water is more variable than in the rest of the ocean. Fresh water and wind from the land can carry chemicals that alter the pH of near-shore water, making it either more acidic or more alkaline. There may be organisms in this region that are already starting to adapt to changes in ocean acidity, Potts said.

"We should be thinking in terms of triage," he said. "We want to be predicting where are the organisms that are most likely to survive or survive the longest, and this is where we should be concentrating our conservation and management efforts, given finite resources" (http://www.sciencedaily.com/releases/2008/12/081217190334.htm, accessed 30 April 2009, our editing).

Study Unit 11

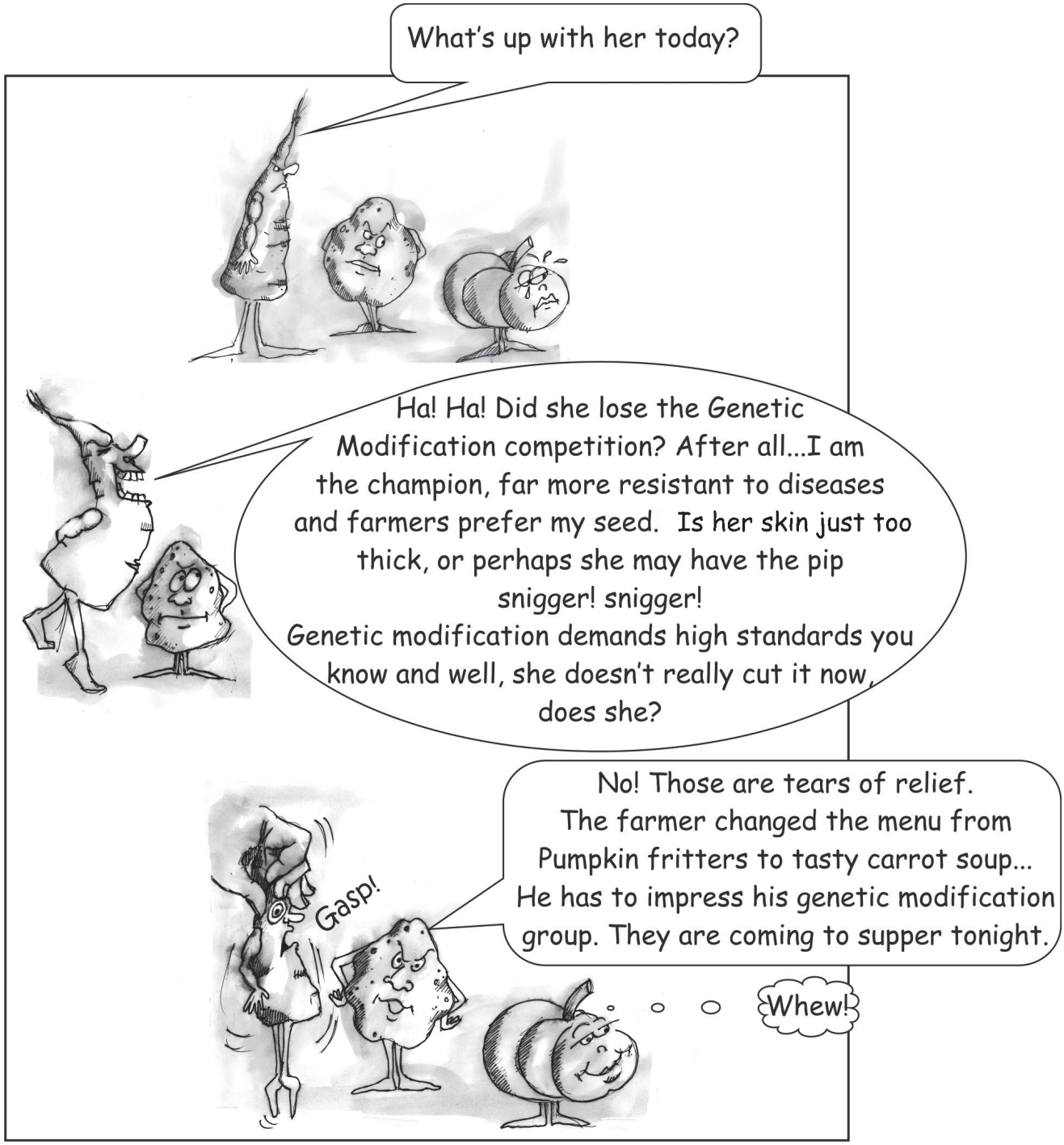
Food production

Did you know?

Approximately 70 million people died of famine in the twentieth century, including an estimated 400,000 in Ethiopia in the 1980s. These large-scale famines shocked the world and pointed to the lack of timely information – prompting the creation of an early warning system for famine by the U.S. Agency for International Development (USAID) in 1985. The warning system has since evolved into a worldwide Famine Early Warning System Network (FEWS NET) that uses NASA data to classify food insecurity levels and alert authorities to predicted crises.

FEWS NET monitors food security in 20 African countries, Guatemala, Haiti and Afghanistan. NASA and its partners, including the U.S. Geological Survey, the National Oceanic and Atmospheric Administration and the U.S. Department of Agriculture (USDA), provide accurate and timely data products into FEWS NET. NASA's data on long-term changes in rainfall, vegetation, reservoir height and other climate factors significantly enhance USAID's ability to accurately predict food shortages and disseminate these findings to a broad audience around the world in a timely manner

(http://earthobservatory.nasa.gov/Newsroom/view.php?id=38856, accessed 30 April 2009).


What's up with her today?
Ha! Ha! Did she lose the Genetic Modification competition? After all...I am the champion, far more resistant to diseases and farmers prefer my seed. Is her skin just too thick, or perhaps she may have the pip snigger! snigger!
Genetic modification demands high standards you know and well, she doesn't really cut it now, does she?
Gasp!
No! Those are tears of relief. The farmer changed the menu from Pumpkin fritters to tasty carrot soup... He has to impress his genetic modification group. They are coming to supper tonight.
Whew!

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Malnutrition and hunger

Atlas: World map poverty and food security

Prescribed book: Chapter 13, "Food production", on pages 257–277 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- explain the relationship between food, population numbers and technology
- explain the development of agriculture through the three agricultural revolutions
- describe the change in agricultural systems during the past 200 years
- explain what the Green Revolution and Blue Revolution entailed, and what their impacts were
- discuss and explain the spatial distribution of hunger in the world
- describe the impact of food production on the natural environment
- explain why it is necessary to practice sustainable agriculture

Introduction

The provision of enough food for every person on earth is one of the greatest challenges of the 21st century. Food is one of humankind's most basic needs, and since the beginning of their existence on earth people have been involved in producing and making enough food available for everyone. In 1798 Malthus warned that a growing population would need increasing food supplies, but that the supply of food in the natural environment was limited. He believed that population numbers would always grow more rapidly than food supplies, which would give rise to cycles of mass starvation. This would, in turn, reduce population numbers.

In the past 200 years, we have been able to increase world food supplies more rapidly than population numbers have increased. We know that population numbers have grown considerably and that there are more than six billion people in the world today. The question we have to ask is how we have been able to increase the food supply so drastically. The answer is to be found in human culture and technology.

New areas have been opened up for farming, crops have been spread and established across the world, there have been major improvements in transport and storage facilities, new pesticides and fertilisers have become available, and farming has become increasingly commercialised. Technology is being used more and more in agriculture and especially in food production. This technology includes selective

breeding and cultivation, the development of biotic fertilisers and pesticides, the improvement of farming implements and the use of biotechnology.

Although global food production has increased over the past few decades and the per capita production of food is currently sufficient to meet the basic nutritional needs of everyone on earth, the world is not without problems related to food. Whereas per capita food production has increased in developed countries, it has decreased in many developing countries. In some countries, population numbers have exceeded those countries' ability to produce enough food for their people. In a world where enough food is produced for everyone, there are still areas where people are hungry and even starving.

Although agriculture and technology make it possible for us to meet our food needs, they are also responsible for many of the world's environmental problems. Agriculture uses more of the earth's natural resources, creates more pollution and is responsible for more environmental degradation than any other human activity. This is a situation requiring our urgent attention. The global food and agricultural system should be economically, socially and ecologically sustainable. It should be managed in a sustainable manner to ensure that environmental degradation is kept to a minimum while enough food is produced to meet the needs of an ever-increasing world population.

Agricultural change

Reading activity

Study the introductory paragraph and the section "Agricultural change" on pages 256–260 in Middleton.

Reading organiser

- The earliest humans who took their food directly from the natural environment (hunter-gatherers).
- Domesticating of natural plants and animals by people.
- Over time people increasingly gained control over food supplies.
- The reason for opening up more and more new areas for agriculture.
- The first agricultural activities focussed on the development of trade and a market-oriented agricultural system (commercial farming).
- The three agricultural revolutions: the Neolithic Revolution, the Industrial Revolution and the Green Revolution.
- Impact of each revolution on the environment.
- The increase of control over the natural environment.

Textbook activity

- What was the first agricultural revolution and where did it begin? Identify these areas on your world map.

- Using an example, explain what domestication means and how it gave humans greater control over food sources.
- Discuss the various ways in which we have increased the world's food supplies in the past 200 years and their effect on the natural environment.
- In which biomes do human agricultural activities have the greatest effect?
- Why are these biomes worst affected?
- Where are these biomes found on the world map?
- Explain the meaning of the Green Revolution and the impact on world food production.

Fertilizer use, irrigation, agricultural pests

Reading activity

Study the following sections in Middleton:

- "Fertilizer use" on pages 260–262
- "Irrigation" on pages 262–264
- "Agricultural pests" on page 264
  - "Pesticides" on pages 264–266
  - "Alternatives to pesticides" on pages 266–268

Reading organiser

- The use of chemical fertilisers and pesticides in the agricultural systems of the world.
- The effect of chemical fertilisers and pesticides on the natural environment.
- The impact of irrigation on the natural environment.
- The effect of pesticides on the natural environment.
- Five alternative methods for controlling pests, which can be used instead of chemical pesticides in the food production system.

Textbook activity

- Discuss the use of chemical fertilisers in agriculture.
- What effects do chemical fertilisers have on the natural environment?
- What is the effect of irrigation on the natural environment? Discuss the use of chemical pesticides in the agricultural systems of the world. What effects do chemical pesticides have on the natural environment? Also refer to aspects discussed in previous study units.
- Explain the benefits of alternative methods for controlling pests.

Biotechnology

Reading activity

Study the section "Biotechnology" on pages 268–272 in Middleton.

Reading organiser

- The meaning of the term "biotechnology".
- Examples of how biotechnology can help solve the world's food problems.
- Biotechnology in the developing countries of the world.
- Human and environmental problems associated with the use of biotechnology in food production.
- The link between biotechnology and preserving the earth's biodiversity.

Textbook activity

- What does the term "biotechnology" mean?
- Explain by means of an example how biotechnology can help to solve the world's food problems.
- Can biotechnology be used to solve food problems in the developing countries of the world? Give reasons for your answer.
- Discuss the human and environmental problems associated with the use of biotechnology in food production.
- What is the link between biotechnology and preserving the earth's biodiversity?

Sustainable agriculture and food security

Reading activity

Study the section "Sustainable agriculture and food security" on pages 272–274 in Middleton.

Reading organiser

- What sustainable agriculture involves.
- Criteria for sustainable agriculture according to Lockeretz (1988).
- The relationship between population numbers, food supplies and the natural environment over the centuries.

Textbook activity

- Explain by means of an appropriate example what sustainable agriculture involves.

- Name the ten criteria for sustainable agriculture according to Lockeretz (1988).
- Look at your own way of life and give at least two ways in which you could cut down on food wastage.
- Explain what the relationship between population numbers, food supplies and the natural environment has been over the centuries.

Aquaculture

Reading activity

Study the section "Aquaculture" on pages 274–276 in Middleton.

Reading organiser

- What aquaculture is.
- How aquaculture can help solve the world's food problems.
- The environmental impact of aquaculture and the Blue Revolution.

Textbook activity

- Explain what aquaculture is and
- Describe how aquaculture can help solve the world's food problems.
- What is the environmental impact of aquaculture and the Blue Revolution?

Conclusion

Each of us has a role to play in bringing about the shift from unsustainable to sustainable agriculture on a local, national, and global level. The greatest challenge facing us at the beginning of the 21st century is how to produce enough food for everyone on earth, at the same time ensuring that each person on earth can meet his or her own food needs. This means that poverty has to be reduced and population growth rates stabilised, to ensure that the number of people in the world will not increase. The next challenge is to provide enough food in a system in which the natural environment is protected against misuse and degradation.

Study Unit 12

Soil erosion

Did you know?

Annual soil loss in South Africa is estimated at 300–400 million tonnes, nearly three tonnes for each hectare of land.

Replacing the soil nutrients carried out to sea by our rivers each year, with fertilizer, would cost R1000 million.

For every tonne of maize, wheat, sugar or other agricultural crop produced, South Africa loses an average of 20 tonnes of soil.

The FAO (Food and Agriculture Organisation, a branch of United Nations) estimates that the global loss of productive land through erosion is 5–7 million ha/year

(http://www.botany.uwc.ac.za/envfacts/facts/erosion.htm, accessed 30 April 2009).

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Soil erosion

Atlas: World map soil erosion

Prescribed book: Chapter 14, "Soil erosion", on pages 278–294 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- explain what soil degradation is and the processes through which it occurs
- describe the causes and results of soil degradation
- explain how soil degradation is interwoven with socioeconomic conditions
- evaluate the complexities involved in lessening the impact thereof

Introduction

Soil is one of humankind's most important natural resources because all food production depends on soil productivity. However, soil is probably the resource that is the least appreciated. In fact, reports on soil erosion do not reach the front pages of newspapers. World issues such as pollution, hunger, war and the threatened survival of endangered species such as the rhinoceros and the koala bear are much more newsworthy than soil degradation. Nevertheless, soil degradation – or the loss of soil productivity – is a critical global problem. It is an enormous issue confronting humankind at the beginning of the 21st century. In this study unit, we concentrate on what soil degradation is, under what conditions it occurs, where it occurs in the world and how to control it.

"Soil degradation" is a term referring to the loss of soil productivity. Soil that has been degraded is soil that has already deteriorated to such an extent that its present or future capacity to support human existence and survival has been reduced or destroyed. The capability to sustain productivity in the agricultural sector in particular is being seriously threatened by soil degradation. However, the irony of the matter is that it is in fact farming practices that have, until recently, been the main cause of the degradation of soil resources.

Erosion is a natural process that we cannot stop and without which the earth's relief variation, the deltas and the present outlines of continents would never have developed. Soil erosion taking place at the rate that nature intended is not however responsible for the alarming worldwide degradation of soil resources. The latter is the result of accelerated erosion, which is erosion taking place at much faster rates as result of human activities.

Factors affecting soil erosion

Reading activity

Study the introductory paragraphs of this chapter on page 278 in Middleton, and the section "Factors affecting soil erosion" on pages 278–280.

Reading organiser

- Pay particular attention to the distinction between balanced erosion as a natural geomorphologic process, and accelerated erosion caused by people.
- Wind and water as the two main agents of erosion.
- Wind erosion transfers soil particles by means of surface creep, saltation and suspension.
- In the case of suspension, the source area and the area of deposition may be thousands of kilometres apart.
- Erosion by water is caused by both the impact that falling raindrops have on soil particles (rain splash) and water runoff.
- When a water droplet strikes the soil, soil particles are disturbed and set in motion. If the rainfall rate (intensity) exceeds the infiltration capacity of the soil, the water starts flowing over the land surface as overland flow. Overland flow consists of narrow, shallow layers of water that converge only periodically in places.
- Overland flow also initiates erosion known as rain-wash. Lower down along the runoff slope, the overland flow converges. The greater erosive force leads to the formation of runoff grooves or rills with steep sides that are only a few centimetres deep.
- Where and when soil erosion takes place, is determined by the interaction between the force of the eroding agent (water or wind) and the erodibility of the soil surface.
- The erosivity factor refers to the ability of the agent of erosion to erode the soil surface.
- Erodibility, on the other hand, concerns the degree to which the soil surface can resist this erosive onslaught or otherwise.

Textbook activity

- Give reasons to explain why people probably attach the least value to soil as a resource base.
- Give a concise description of the extent of soil erosion on a global scale.
- Write down the essential facts and arguments that you could use in a brief speech on "The time has dawned for South Africans to change their attitude to soil as a resource".
- Study figure 14.1 on page 279 in Middleton. Make a list of the variables that play a role in soil erosion by water, and explain how these variables influence erosion.

- Identify the two natural surfaces (excluding tarred or paved surfaces) in your living or work environment which, in your opinion, stand the least and the greatest chance respectively of being eroded.

Measuring soil erosion

Reading activity

Study the section "Measuring soil erosion" on pages 280–282 in Middleton.

Reading organiser

- The various assumptions on which the measurement and forecasts of soil erosion are based.
- The lack of global data on erosion and the initiative that was launched to address the problem.
- Make sure you understand the universal soil loss equation model.

Textbook activity

- To what are we referring when we state that techniques that were developed to measure erosion often do not measure erosion as such, but are in fact a measurable consequence of erosion?
- Describe the usage of the universal soil loss equation model.
- Name the variables for which data must be collected in order to apply this model.

Effects of erosion

On-site and off-site effects

Reading activity

Study the sections "Effects of erosion", "On-site effects," and "Off-site effects" on pages 282–284 in Middleton.

Reading organiser

- Erosion has an impact on the environment at the place where soil particles are lifted and carried (entrained), along the entire route over which they are transported, and at the place where the transported material is deposited.
- Lifting and carrying or entrainment is the first phase in the erosion process. This is where the soil particles are disturbed and set in motion. The entrainment of material has on-site effects affecting the land surface in the source area.
- The reduction of an area's capacity to support plant growth is certainly the most important on-site effect of soil erosion.

- Seriously eroded areas are known as badlands and are frequently characterised by deep erosion gullies. The removal of the topsoil exposes the deeper-lying hardpans and duricrusts in the soil. Water cannot infiltrate these dense, impervious layers, and plant roots cannot penetrate them, with the result that plants are unable to grow there.
- Impacts of the transportation and deposition of material are experienced beyond the source area, and are known as off-site effects. In fact, deposition could occur thousands of kilometres from the source area.

Textbook activity

- Describe the negative effects that wind erosion could have on agriculture and the nature of the soil.
- With the exception of Africa, wind erosion has affected a much smaller area on each continent than water erosion. To what do you attribute the difference between Africa and the other continents?
- The deposition of transported material influences human activities in a negative way only.'' Indicate whether you agree or disagree with this statement and substantiate your viewpoint.

Accelerated erosion

Reading activity

Study the section "Accelerated erosion" on pages 285–291 in Middleton.

Reading organiser

- The role of human activities in the acceleration of erosion.

Textbook activity

- Name five reasons why the natural erosion rates for two different areas might differ.
- Name two of the most common human activities that give rise to accelerated erosion.
- What motivates people to remove or destroy vegetation?
- Name three examples of human activities that lead to the destabilisation of natural land surfaces, and briefly explain how each of these activities destabilises the surface in question.

Soil conservation

Reading activity

Study the section "Soil conservation" on pages 291–293 in Middleton.

Reading organiser

- the three categories for classifying soil protection techniques
- the basic differences between these categories
- Land cultivation practices, table 14.7 on page 292

Textbook activity

- Name the three categories for classifying soil protection techniques and indicate what the basic differences between these categories are.
- A friend bought a small farm and plans to cultivate vegetables under irrigation on a moderate slope. Advise your friend on low-cost soil conservation techniques that he or she should consider.
- Land cultivation practices: Use table 14.7 on page 292 in Middleton to rearrange the utilisation and cultivation practices in such a way that the practice resulting in the least soil loss is listed first. The practice that results in the greatest erosion should be written at number 10.
- Study the sequence in your table and describe the trend that emerges from it.

Implementation of soil conservation measures

Reading activity

Study the section "Implementation of soil conservation measures" on pages 293–294 in Middleton.

Reading organiser

- It is clear that, although we know how erosion starts, what factors it is affected by, and how it can be controlled, soil conservation projects in the developing world in particular seldom yield the desired results.
- The main reason that can be offered as explanation, is that the projects are frequently based on faulty assumptions by both donor organisations and host governments.
- On the donor side, high expectations create illusions among people. If these expectations are not realised, the project, together with the necessary cooperation at grass-roots level – on which success depends – loses its momentum.
- The back-up facilities that Middleton (2008) mentions, could take many different forms. A few examples are:
    - educational programmes to convince people that sustainable utilisation is more profitable in the long term than short-term economic gain
    - agricultural information and advice, that should be available on a continuous basis
    - capital to bridge the gap in cases where it would perhaps be necessary to allow the soil to lie fallow for longer periods
    - conversion to completely new agricultural practices

Textbook activity

- Explain the underlying causes of the large-scale soil degradation in Ethiopia. Substantiate your viewpoint.

Conclusion

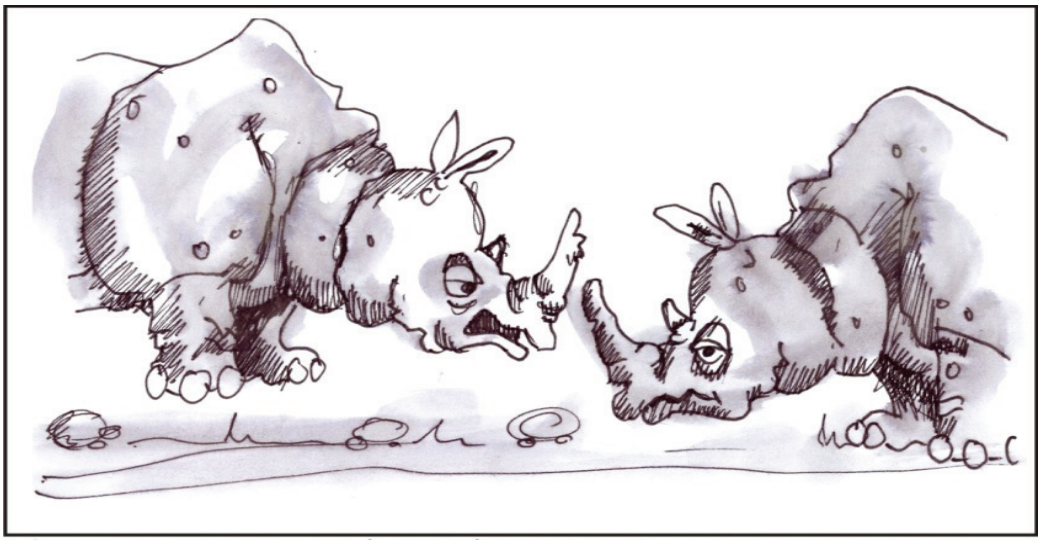
The conclusion we can come to with regard to erosion, is that mistakes have frequently been made in the past by not taking into account underlying socioeconomic and political considerations, as well as the cultural forces and drive for survival that motivate people to use soil in a unsustainable way (http://earthobservatory.nasa.gov/Features/BAER/, accessed 30 April 2009).

Study Unit 13

Biodiversity loss

Did you know?

The two domestic cats that were taken to the weather station on Marion Island provide a perfect example of what happens when a new species is introduced to an island, which in this case led to the extermination of endemic island species. The cats' numbers increased to such an extent that they later became a very real threat to the survival of many bird species on the island. An extermination campaign eventually had to be launched against the cats to save the situation.



Humans are confusing...First they hunt us to almost extinction, and then they decide to protect us.

Sources to consult

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Biodiversity loss

Atlas: World map of biodiversity loss

Prescribed book: Chapter 15, "Biodiversity loss", on pages 296–316 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- explain what "biodiversity" means
- name six fundamental causes of the loss of biodiversity due to human activities
- explain how threatened species are classified
- explain how the loss and modification of habitats, specifically deforestation, contribute to the loss of biodiversity
- explain how the overexploitation of biotic resources contributes to the loss of biodiversity
- briefly discuss the efforts being made to counteract the loss of biodiversity

Introduction

The loss of biodiversity has various implications. One of the most direct implications is that the extinction of plant and animal species inevitably damage the functioning of ecosystems in some way. The removal of a single species from a food chain can have far-reaching consequences. The possibility of using undiscovered species for food, fuel, medicine or fibre, obviously disappears when species go extinct. The extinction of species also detracts from our knowledge and understanding of how nature functions. Above all, the extinction of plant and animal species has an ethical component: do people have the right to take away other species' right to life?

Ecosystem modification and species extinction are as old as the earth itself, and can be ascribed to phenomena such as volcanic eruptions, climate change (eg ice ages and prolonged droughts) and veld fires. Today, however, people play a key role in the threat to biodiversity.

The risk of extinction is not equally great for all species and in all parts of the world. Some species face a greater risk of extinction because, for example, they can only live in specific conditions, while others only occur in very small numbers.

Most of the threats facing flora (plants) and fauna (animals) at present can be linked in some way to human influences. Human actions threatening biodiversity can be

divided into deliberate actions, such as hunting and trade in animal products (eg rhinoceros horn) and unintentional actions, for example putting land to different uses and thereby destroying or modifying habitats.

In many countries, particularly those with high population densities, the demand for land for activities such as agriculture, settlement and industries has become so strong, that the natural habitats of animals and plants have already largely been destroyed.

In addition to causing habitat loss and modification, people are implicated as the main role-players in the extermination of species through the blatant, thoughtless, selfish and short-sighted way in which they exploit and often overexploit species for their own benefit and sometimes purely for pleasure.

Accurate estimations of the biological, social and economic impact of the loss of biodiversity are complicated by a lack of information and certainty about many aspects. For this reason, it is probably safest to apply the "precautionary principle," in other words to slip up in our efforts to reverse trends in species extermination and biodiversity loss rather than to err by doing nothing about the problem.

An alternative approach to preserving biodiversity, is to try to protect threatened species individually (ie on a species level). This includes efforts to stop the hunting of and trade in threatened species.

Although conservation aims are usually achieved best in nature, this is not always practically possible, especially in the case of species whose numbers are very small and which, in addition, do not occur in conservation areas. In such cases, the species can be conserved in artificial conditions, for example by transferring fauna to zoos, game farms, or aquariums and by cultivating flora in botanical gardens.

Understanding biodiversity

Reading activity

Study the two introductory paragraphs of the chapter, and the section "Understanding biodiversity" on pages 296–298 in Middleton.

Reading organiser

- The definition of biodiversity.
- Meaning of:
  - genetic diversity
  - species diversity
  - ecosystem diversity
- The natural dynamics of species.
- The reason(s) why the biodiversity issue is currently in the spotlight.
- Humankind's role in the loss of biodiversity.

- The lack of knowledge about biodiversity, the world's biomes (natural regions) and ecosystems, and the consequences of this lack of knowledge.
- Trends in the loss of biodiversity.

Textbook activity

- Briefly describe the meaning of each of the following concepts in your own words:
  - genetic diversity
  - species diversity
  - ecosystem diversity
- Briefly define the conclusions of the United Nations Conference on Environment and Development, which was held in Rio de Janeiro in 1992.
- Approximately how many species occur on earth? How many have been scientifically described and classified?
- Describe the trend over time as regards the extinction of species because of human activities.

Threats to biodiversity

Reading activity

Study the section "Threats to biodiversity" on pages 298–299 in Middleton.

Reading organiser

- The various natural phenomena and circumstances that can lead to the extinction of species.
- Scientific evidence for species' extinction in the history of the earth.
- The six fundamental causes of the loss of biodiversity as a result of human activities.

Textbook activity

- Briefly explain how climate change can lead to the extinction of species.
- Substantiate the following statement: "The uncontrolled increase in the number of people on earth is a threat to the survival of certain species."

Threatened species

Reading activity

Study the section "Threatened species" on pages 299–300 in Middleton.

Reading organiser

- Factors determining the risk of extinction of species.

- The difference between *K*-strategist and *r*-strategist species.
- The role of keystone species and how their extinction can lead to a chain reaction of extinctions of other species.
- How data on species' risk of extinction are classified on the Red Data List.

Textbook activity

- Briefly explain the difference between a vulnerable and an endangered species.
- What is the Red Data List?

Threats to flora and fauna

Reading activity

Study the section "Threats to flora and fauna" on page 300 in Middleton.

Reading organiser

- Species often face different threats simultaneously.
- The threats to species vary over time.
- The chain of events that culminated in the extinction of New Zealand mistletoe.
- The seven categories into which most threats to mammals in Australasia and the Americas, and birds in the world can be classified.
- That species have become extinct because of human activities over centuries and not only in the past few decades.

Textbook activity

- Which activities of the earlier African colonists caused the numbers of various species of fauna to decline?

Habitat loss and modification

Reading activity

Study the section "Habitat loss and modification" on pages 301–304 in Middleton.

Reading organiser

- The extent of habitat loss in the world, with reference to different continents, countries and natural regions (biomes).
- The giant panda as an example of a species whose survival is threatened by habitat loss.
- The consequences of the fragmentation of habitats for species.

- The dung beetles of the Amazon forest as an example of a species that is affected by the fragmentation of habitats.
- The changes that occur in habitats as a result of pollution through human activities. Note in particular water pollution, air pollution and the role of poisons in agriculture.

Textbook activity

- What is the approximate extent of habitat loss in the tropical parts of Africa and Asia?
- Why are pandas a threatened species?
- Why are dung beetles a valuable species? What is threatening the survival of dung beetles in the Amazon basin?
- What is DDT, what is it used for and how does it affect raptors?

Overexploitation

Reading activity

Study the section "Overexploitation" on pages 304–305 in Middleton.

Reading organiser

- Scientific evidence of the overexploitation of fauna from the Stone Age to the Late Pleistocene.
- Overexploitation of fauna in Roman times.
- The dodo and the North American passenger pigeon as examples of fauna that became extinct because of overexploitation.
- The elephant and certain whales as examples of fauna that are threatened because of the relatively high prices obtained for their products on international markets.
- In the case of flora species, there is a connection between overexploitation and market demand.
- Examples of the extinction of flora because of overexploitation.

Textbook activity

- Discuss the impact of overexploitation and illustrate by means of relevant examples.

Island species

Reading activity

Study the section "Island species" on pages 305–308 in Middleton.

Reading organiser

- The reasons why species on islands are particularly vulnerable to extermination.
- Madagascar as an example of an island where many fauna species have already become extinct, probably because of indiscriminate hunting.
- How the introduction of goats affected ecosystems on St Helena.
- How new, exotic fauna threaten endemic (indigenous) fauna on islands.
- Hawaii as an example of an island where some species became extinct long before the arrival of colonists.
- Examples of cases where the introduction of a single new species to an island lead to the extinction of a whole series of endemic island species.

Textbook activity

- Use your atlas to make sure that you know where the following islands, referred to in chapter 15 in Middleton (pp 306–307), are situated:
  - Hawaii
  - Madagascar
  - St Helena
  - Guam
  - Mauritius
  - Juan Fernandez

Conservation efforts

Reading activity

Study the introductory paragraphs of the section "Conservation efforts" on pages 308–309 in Middleton.

Reading organiser

- Make sure you understand the various arguments for and against preserving biodiversity. Note that people have different views on biodiversity, and that these views (that are actually perceptions) change over time.
- Despite different perceptions of biodiversity, most people agree that it is necessary to protect habitats against the causes of destruction, modification and fragmentation. This is because these three processes together are the main threat to biodiversity.

Textbook activity

- Why is biodiversity valuable to humans?

Habitat protection

Reading activity

Study the section "Habitat protection" on pages 310–13 in Middleton.

Reading organiser

- Percentage of the earth's surface where habitats are currently protected.
- Spatial variation in the percentage of protected or preserved areas (ie how this percentage varies from country to country).
- Relative representation of the various biomes in the areas that are protected.
- Variation in the type and quality of conservation and management in the various areas and the reasons for this variation.
- Conflict between the aims of conservation and the aims of local populations in and around protected areas.
- An illustration of the above is conflict around efforts to prevent the extinction of the tiger in Asia.
- Some reasons why the conservation of habitats is generally problematic.
- The importance of knowledge and information to effective conservation of habitats.

Textbook activity

- What percentage of the earth's surface is currently covered by conservation areas?

Bans on hunting and trade

Reading activity

Study the section "Bans on hunting and trade" on pages 313–314 in Middleton.

Reading organiser

- The role of legislation and international agreements in banning the hunting of and trade in threatened species.
- Factors diluting the effect of legislation, agreements and treaties.
- Problems surrounding efforts to protect the African elephant, and the role of legislation and agreements in this regard.
- The role of the Convention on International Trade in Endangered Species (CITES) in stopping the trade in threatened species.
- The argument that a total boycott on products from threatened species is the only long-term solution.

Textbook activity

- What are Ramsar and CITES?
- Why did the price of ivory fall so drastically in 1989? What was the effect of this on the illegal hunting of elephants in Africa?

Off-site conservation practices

Reading activity

Study the section "Off-site conservation practices" on pages 314–315 in Middleton.

Reading organiser

- Off-site conservation complements conservation in nature but will never be able to replace conservation in nature.
- The main functions of off-site conservation are to create research opportunities and to provide individual members of threatened species for re-establishment in the wild.
- Advantages and disadvantages of off-site conservation.
- Problems in implementing off-site conservation programmes.

Textbook activity

- Compare the advantages and disadvantages of off-site conservation. Illustrate your answer by means of examples of the implementation of off-site conservation.

Convention on biological diversity

Reading activity

Study section "Convention on biological diversity" on page 316 in Middleton.

Reading organiser

- Make sure that you are aware of the aims of the Convention on Biological Diversity and of how these aims are to be achieved.
- The stipulations of this convention regarding the sustainable use and conservation of biodiversity.

Textbook activity

- Explain why the sustainable use and conservation of biodiversity make demands on countries.

Conclusion

Red List of endangered species – wildlife disappearing as never before

By Paul Eccleston

Published: 1:00PM BST 12 Sep 2007

Human activity causing loss of habitat through urbanisation, agriculture and deforestation combined with climate change is revealed to be the biggest threat to plants and animals.

There are now 41,415 species on the Red List and 16,306 are threatened with extinction, up from 16,118 last year. The total number of extinct species has reached 785 and a further 65 are only found in captivity or in cultivation.

The Red List is recognised as the most reliable evaluation of the world's species, which it classifies according to their extinction risk. Its publication is the latest wake-up call to the pressures facing the earth's fragile ecosystems and its consequences for humankind.

The one small success story on the 2007 Red List is the Mauritius Echo Parakeet (Psittacula eques), which 15 years ago was one of the world's rarest parrots. Following successful conservation efforts it has been moved from Critically Endangered to merely Endangered.

Julia Marton-Lefèvre, Director General of the IUCN said: "This year's IUCN Red List shows that the invaluable efforts made so far to protect species are not enough.

"The rate of biodiversity loss is increasing and we need to act now to significantly reduce it and stave off this global extinction crisis. This can be done, but only with a concerted effort by all levels of society."

Jane Smart, Head of IUCN's Species Programme, said: "We need to know the precise status of species in order to take the appropriate action. The Red List does this by measuring the overall status of biodiversity, the rate at which it is being lost and the causes of decline.

"Our lives are inextricably linked with biodiversity and ultimately its protection is essential for our very survival. As the world begins to respond to the current crisis of biodiversity loss, the information from the Red List is needed to design and implement effective conservation strategies – for the benefit of people and nature."

Dr Mark Wright, chief scientist at WWF-UK, said: "We're at code red. The plight of the world's species is a mirror on the state of the planet. Species are under enormous pressure as we systematically destroy their habitat or over-exploit them for our increasingly demanding lifestyles. "We urgently need to reverse this trend and start living within the planet's natural resources – not just for the well-being of threatened species but also for our own."

Three of the new species added to this year's list are corals in the Galapagos Islands, which are said to be critically endangered by the warm-water Pacific Ocean pattern El Nino and by climate change.

Craig Hilton-Tailor, the list's manager, said climate change was one factor threatening plant and animal life but not the only one. "It's really hard to identify whether it's climate change or not that's driving some of these species to extinction," he said.

"Climate change doesn't operate by itself, it's operating in tandem with other threats, and it's usually the combination of climate change and possibly the threat of a new disease ... its different combinations that can push species over the brink. If everybody on the planet cooperated and adopted a sustainable way of living, a lot of these problems would go away," he said

(http://www.telegraph.co.uk/earth/wildlife/3306508/Red-List-of-endangered-species-wildlife-disappearing-as-never-before.html).

Study Unit 14

Waste management

Did you know?

Waste is one of the biggest environmental problems the world has to deal with today. It is also a big problem in South Africa. It is estimated that every year, thoughtless people drop 200 000 tons of litter in South Africa. Added to this is a shocking 1,3 million tons of packaging material (glass/plastic bottles, cans and paper, cardboard and polystyrene containers) which is used every year and eventually ends up on rubbish dumps.

The types of waste people want to get rid of, is related to their life and world view. It therefore differs from person to person, from one cultural group to another, and from one socio-economic group to another. What is waste to one person or group of people is sometimes a resource to another person or group

(http://www.solidwaste.co.za/p-facts-display.php, accessed 30 April 2009).

Sources to consult

DVD clip 5

myUnisa: http://www.unisa.ac.za

- **Go to:** View all: Departments
- **Click on:** Academic Geography
- **Click on:** Links: *National Geographic*
- **Search:** Waste

Prescribed book: Chapter 17, "Waste management", on pages 337–352 in Middleton

Learning outcomes

After completing this study unit, you should be able to

- name the four forms in which waste occurs
- make a list of the various sources of waste
- explain which properties of waste make it difficult to dispose of
- explain what hazardous waste is and how it is classified
- distinguish between the controlled and uncontrolled release of waste into the environment
- explain what a landfill is and what problems are associated with landfills
- explain what the burning of waste entails and what problems are associated with it
- distinguish between reuse, recovery and recycling, and give examples of each
- name the factors that complicate reuse, recovery and recycling
- briefly discuss the advantages of reuse, recovery and recycling
- briefly discuss the advantages of producing less waste

Introduction

Waste causes problems because we cannot get rid of it. Whether we dump it on a rubbish dump or in a landfill or even burn it, it is never really "gone". Waste never "disappears" or ceases to exist. It always remains in the human-environment system in one form or another. The enormous increase in the number of people on earth in the past 100 years and the related increase in the use of resources are the root causes of the problem.

People produce more and more waste every year, and provision has to be made for disposing of this waste in some way. This throwaway culture is rooted in the unsustainable, economy-dominant or materialistic Western world view of technological progress, high resource consumption and consumerism. The manufacturing sector has encouraged this throwaway culture because repairing consumer items or tools

or replacing single, small parts is no longer considered an economically viable proposition. Things are therefore thrown away rather than repaired, and anything from shoes, clothes and furniture to toasters, radios, sports equipment, watches, fridges and even television sets and computers end up at waste disposal sites.

Poor communities do not throw things away as easily. A lower consumption of resources means less wastage. Although it is widely recognised that the throwaway culture could result in a worldwide disaster in terms of both waste production and resource consumption, it continues to grow in popularity.

Landfill and incineration are currently the two methods most commonly used worldwide to dispose of waste. However, they are not necessarily the best methods or the methods that cause the fewest problems or do the least damage to the environment. As a result of the negative environmental impacts of landfills and incineration, attempts have been made since the 1980s to find alternative approaches to waste management.

The ideal is, of course, that less waste should be produced. More attention is now being given to environmentally friendly efforts to reduce waste production or even to prevent it completely.

Because controls regarding hazardous waste disposal have become increasingly strict in developed countries, waste disposal facilities – and sometimes the waste itself – are being shifted to countries where the legislation is not as strict or not properly enforced. Thus the rich, developed countries are simply exporting their hazardous waste problem to the poor, developing countries. Consequently, some of the latter countries have become the waste disposal sites of the developed countries. It is an alarming phenomenon, because although it is very profitable for participating developing countries (or more often for a couple of individuals in those countries), the inhabitants of the countries importing waste have no say in the matter and could easily be exposed to hazardous waste.

Types of waste

Reading activity

Study the section "Types of waste" on pages 337–338 in Middleton.

Reading organiser

- There are four basic forms of waste.
- Waste can be classified in different ways.
- Certain characteristics of waste make it difficult to dispose of.
- Different human activities generate different types of waste.
- The percentage waste produced in different sectors in the United Kingdom.
- The description of hazardous waste and the treatment thereof.

Textbook activity

- Give an example of each of the following forms in which waste occurs:
  - solid
  - gaseous
  - biodegradable
  - non-combustible
  - poisonous
  - liquid
  - energy
  - combustible
  - hazardous

- Name five sources of waste, and give an example of the types of waste emanating from each source.
- Name the three main sources of waste in the United Kingdom.
- Why is it necessary to follow special procedures for handling and disposing of hazardous waste?

Disposal of waste

Reading activity

Study the introductory paragraph of the section "Disposal of waste" on pages 338–339 in Middleton.

Reading organiser

- Examples of waste that is treated before it is disposed of.
- Examples of waste emitted directly into the environment.
- Consequences of the largely public ownership of the atmosphere, oceans and rivers.
- Various options available for the treatment and disposal of hazardous waste.
- Technology available for treating and disposing of hazardous waste.

Textbook activity

- Give an example of waste that is collected and treated before being released into the environment.
- Give an example of waste that is released straight into the environment without being treated at all.
- Why could waste be dumped into the atmosphere, rivers and oceans so easily and for so long without any control or regulations?
- What are the options for treating and disposing of hazardous waste?

Landfill

Reading activity

Study the section "Landfill" on pages 339–342 in Middleton.

Reading organiser

- In many countries, landfill is the method most commonly used for disposing of municipal waste.
- Landfill is often used for the disposal of hazardous waste.
- Landfill sites that are properly designed and managed, are not necessarily a threat to the environment.
- Two hazards that are associated with landfills.
- Four typical landfill designs, and the sites and situations where each of these designs is used.
- Conditions in which hazardous substances may leak from landfill sites.
- What happens to hazardous substances after they are dumped in the environment.
- Health risks of these hazardous substances.
- What happened when it was established that chemical waste was leaking from the Love Canal landfill site near the town of Niagara Falls in the north-east of the USA.
- The large number of contaminated landfill sites in Germany, the Netherlands and the USA.
- The enormous costs of cleaning up such sites.
- Who is responsible for cleaning up contaminated landfill sites.
- That the future of landfill as a waste disposal method is uncertain, because suitable land is becoming harder to find.

Textbook activity

- Which two hazards are associated with landfill sites?
- What preventative measures can be taken to prevent leakage if a landfill is situated on an aquifer?
- What are the implications for the environment and people if hazardous waste leaks from a landfill site?

Incineration

Reading activity

Study the section "Incineration" on pages 342–343 in Middleton.

Reading organiser

- The increasing popularity of incineration (or burning) as a waste-disposal method.
- Advantages and disadvantages of incineration.
- Generation of energy by incinerating waste.
- The example of used tyres, which are not suitable for disposal on landfill sites but are an excellent supplementary energy source.
- Methods of limiting air pollution resulting from incineration.
- Controversy surrounding the selection of sites for incinerators.
- Role of public opinion in European countries in the imposition of extremely strict limits on the emission of pollutants by incinerators.

Textbook activity

- Study figure 17.5 on page 342 in Middleton. Describe and explain the trend over the past 30 years in the Netherlands regarding waste incineration.
- List the advantages and disadvantage of incineration in table format.
- Explain why incineration is considered a suitable method for disposing of tyres.
- Why is the selection of the site for incinerators a problem?
- Between which groups of countries is hazardous waste usually moved?

International movement of hazardous waste

Reading activity

Study the section "International movement of hazardous waste" on pages 343–344 in Middleton.

Reading organiser

- Increase in trade in hazardous waste during the 1980s.
- Countries trading in hazardous waste.
- What the Basel Convention is, and when it came into force.
- The principles laid down by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Textbook activity

- Give the reason for the movement of hazardous waste across national boundaries.
- What led to the Basel Convention?
- When did the Basel Convention come into force?
- Why was the Basel Convention amended in 1994?

Reuse, recovery, recycling and prevention

Reading activity

Study the introduction to the section "Reuse, recovery, recycling and prevention" on pages 344–345 in Middleton.

Reading organiser

- Advantages of recovery methods like reuse and recycling.
- Waste is transformed into resources by means of these methods.
- Two substances that are now valuable resources, that were originally considered waste products.
- The multinational Minnesota Mining and Manufacturing company's win-win formula for the use of waste.

Textbook activity

- Why does it make more sense from an environmental perspective to reuse or recycle waste rather than throw it away?

Reuse, recovery and recycling

Reading activity

Study the section "Reuse, recovery and recycling on pages 345–350 in Middleton.

Reading organiser

- Difference between the approaches of developed and developing countries to the recovery of waste.
- Advantages of recovery for the environment.
- Critical factors determining the amount of material that can be recovered.
- The role of appropriate legislation in the success of recovery efforts.
- The use of taxes to encourage recovery (eg Denmark).
- Manipulation of the consumer price of products to encourage the reuse of certain items (eg glass bottles).
- Energy savings accomplished by means of the recycling of most metals (eg aluminium cans).
- The extent to which the different types of waste recovery are implemented in the world today.
- Reuse and recycling of waste water and sewage from urban areas, and the associated problems.

Textbook activity

- Discuss the socioeconomic value of waste recycling in developed countries.
- Explain which method can be used to encourage the reuse of items such as glass bottles.
- Compare the advantages and disadvantages of recycling and reusing waste water from urban areas.
- Explain what you do with your recyclable waste (eg tins, bottles and paper).

Waste prevention: cleaner production

Reading activity

Study the section "Waste prevention: cleaner production" on pages 350–352 in Middleton.

Reading organiser

- Purposes of cleaner production.
- How cleaner production can be achieved.
- How sustainability and economic efficiency can be incorporated into cleaner production.
- Industrial examples of cleaner production in table 17.6 on page 352 in Middleton.
- Advantages of cleaner production.
- The relatively short payback period for covering the costs of implementing cleaner production.
- Details of the cleaner production programme implemented by SC Johnson Wax, and the advantages of this programme.

Textbook activity

- Explain what the purpose of cleaner production is. In your answer refer to:
  - methods to achieve cleaner production
  - the advantages of cleaner production

Conclusion

In this study unit, we examined the problems surrounding the waste produced by human activities. You have learned that the production of waste from human activities has increased drastically over the past 100 years. This is obviously related to industrial development (after the Industrial Revolution), the increase in population numbers and the accompanying increase in the rate of resource use over the same period. The disposal of the resultant waste has now become a huge problem. Although landfill and incineration are the two waste disposal methods most commonly used, they are not necessarily the most effective or sustainable methods, and

there are many problems associated with them. Today there is a growing emphasis on waste management methods that limit or prevent the production of waste. Waste disposal methods such as recovery, reuse, recycling and reduction are becoming increasingly popular.

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Appendix
Satelite images

Declining Water Levels in Lake Chad 1972 and 2007

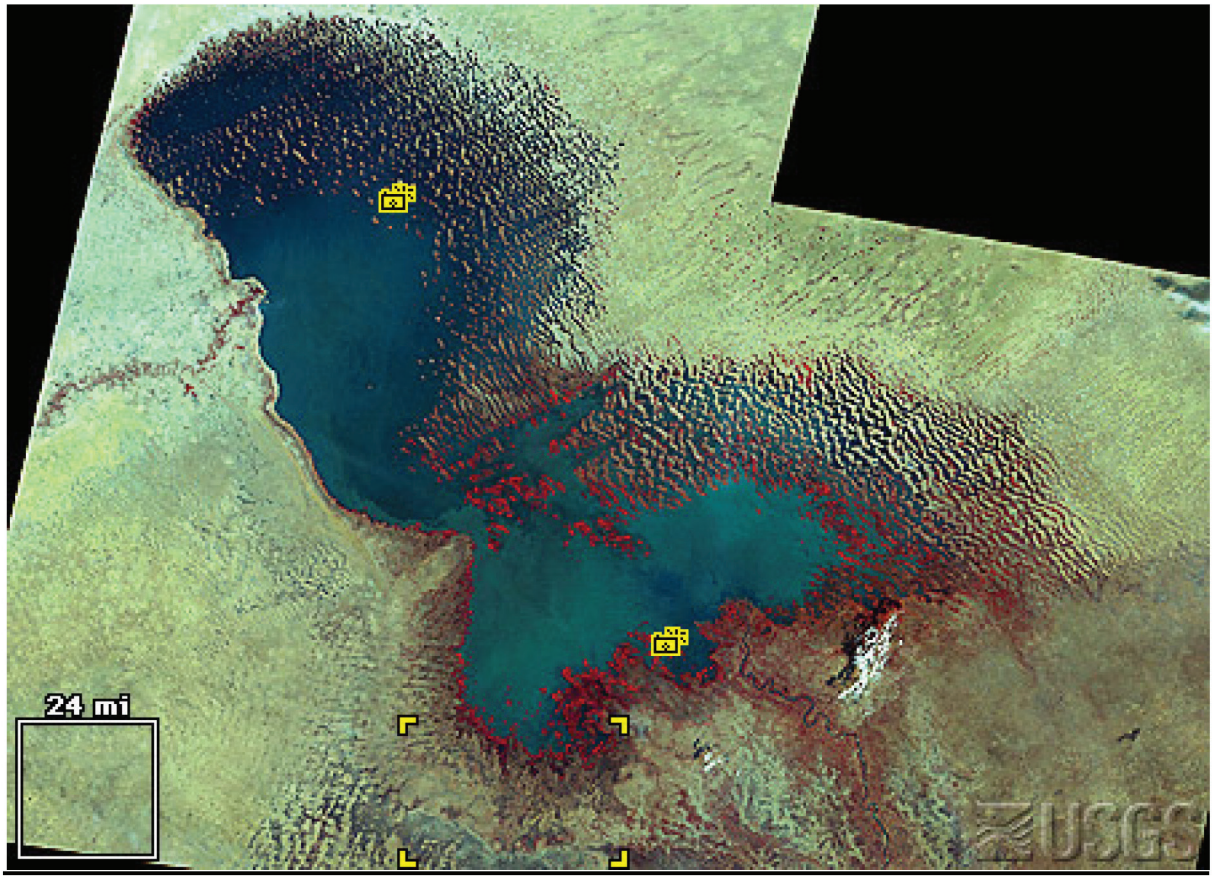
'Located at the southern edge of the Sahara Desert, Lake Chad is bordered by Nigeria, Niger, Chad, and Cameroon. The lake was once the second-largest wetland in Africa, supporting a rich diversity of endemic animals and plant life. The Lake Chad drainage basin, a 2 500 000 km² hydrologically closed catchment, extends to eight countries: Algeria, Libyan Arab Jamahiriya, Niger, Chad, Sudan, Central African Republic, Cameroon, and Nigeria. It is home to over 20 million people who derive direct or indirect livelihoods from the lake. Most of the region's rainfall occurs in the southern one-third of the Lake Chad drainage basin, contributing about 90 per cent of the basin's runoff. The northern two-thirds, however, are dominated by arid conditions.

Climate variability and increased water consumption by the area's inhabitants have changed the water balance within the Lake Chad drainage basin, and continue to do so. Since the early 1960's, rainfall over the basin decreased significantly while irrigation increased dramatically over the same period. The lake is especially susceptible to climatic variability as it is rather shallow, with an average depth of 4.11 m. As a result of decreased rainfall and increased water usage, the extent of Lake Chad decreased by 95 per cent over roughly 35 years. More recently, water levels in Lake Chad have increased slightly. But the lake still remains a remnant of its former self.

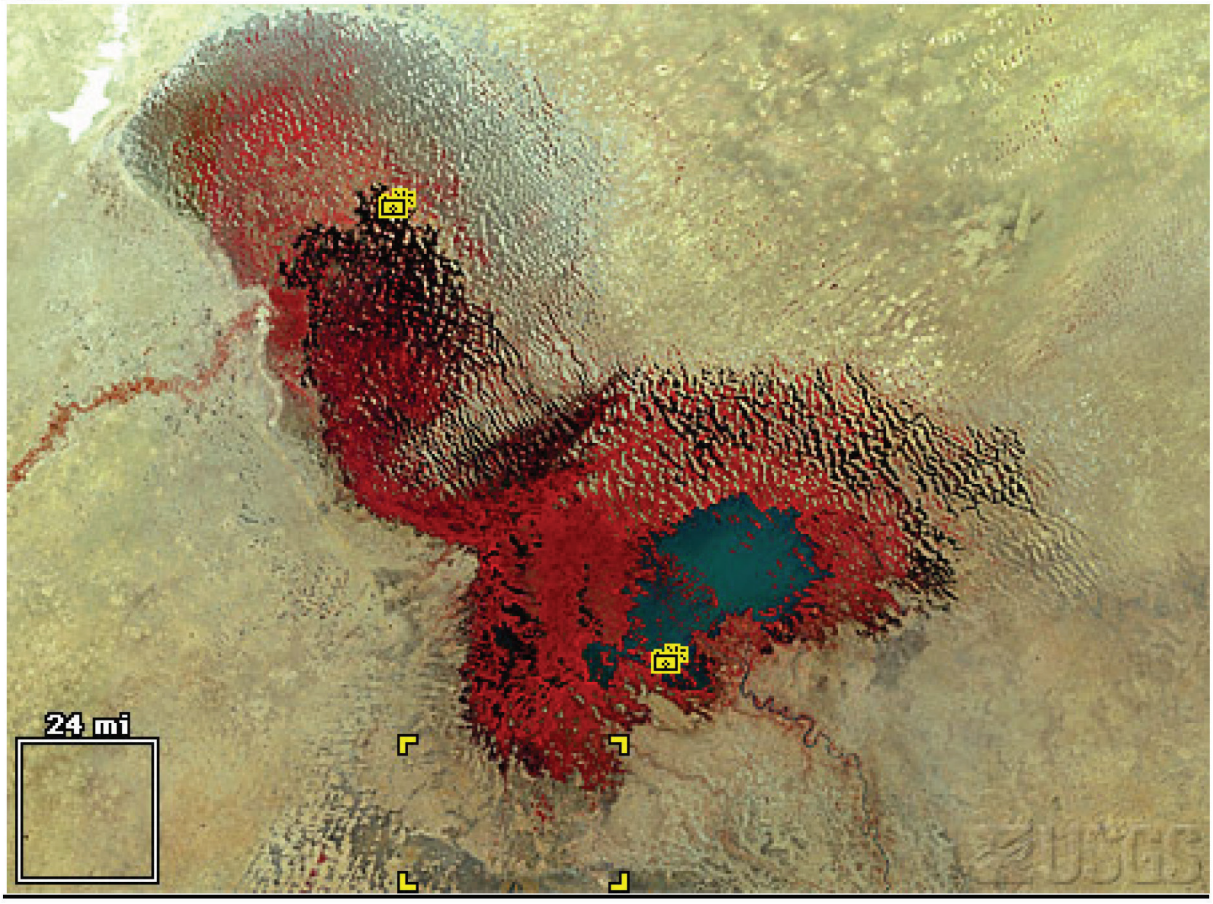
As these satellite images from 1972 to 2007 show, the surface area of the lake has declined dramatically over time.'

(http://na.unep.net/atlas/webatlas.php?id=58)

1972



2007



http://na.unep.net/AfricaAtlas/AfricaAtlas/site_images.php

Impacts of Challawa Dam: 1990 and 2006

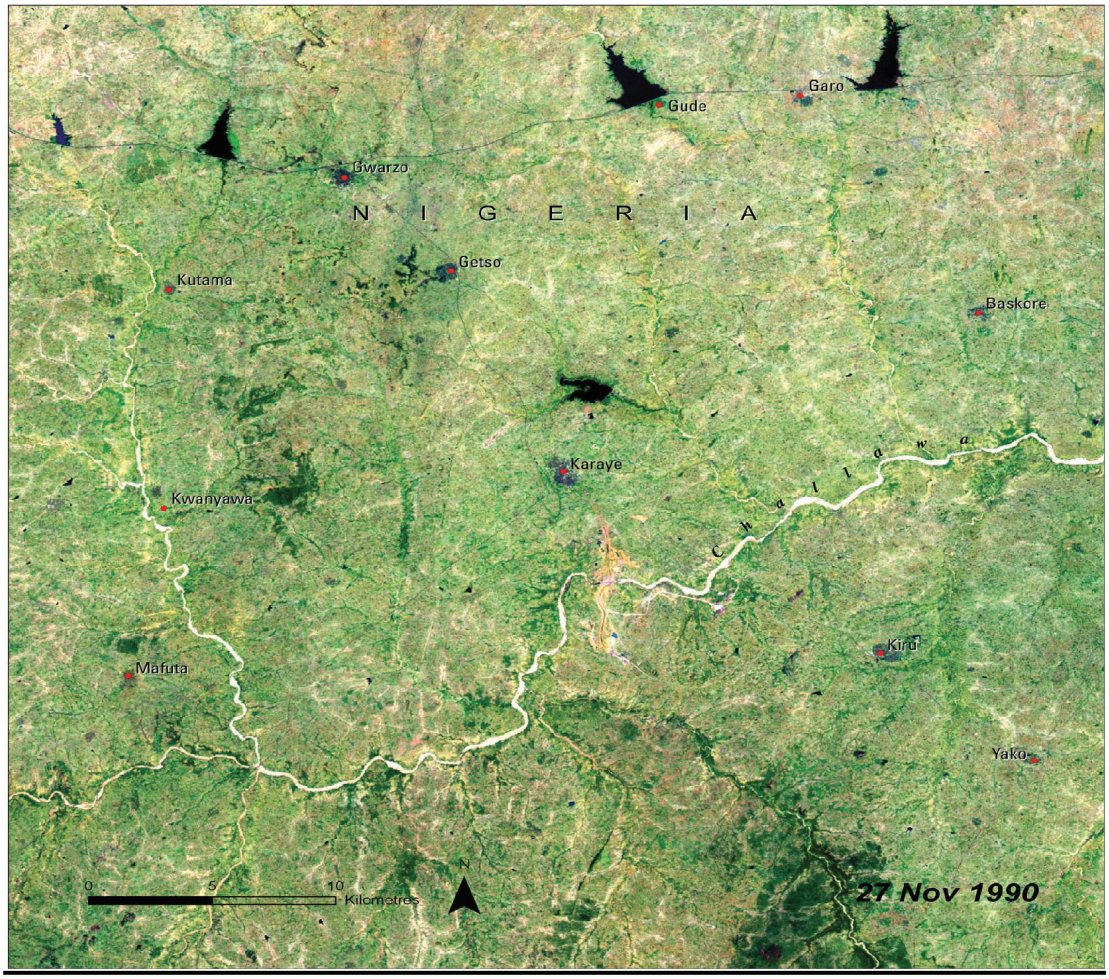
'The Challawa Dam in Kano State, Nigeria, was built to control flooding caused by seasonal and variable rainfall and to support irrigation. It also supplies water to Kano, Nigeria's third-largest city with a population of seven million. The Challawa River feeds into the Hadejia River, which then flows into the Hadejia-Nguru wetlands. Local rainfall peaks in August, with a subsequent dry season lasting from November to April. This rainfall pattern makes water levels in the Hadejia-Nguru wetlands highly seasonal.

The Challawa Dam has tamed highly seasonal downstream flooding at the expense of the Hadejia-Nguru wetlands. The combined effect of drought and the dam reduced the extent of seasonally flooded land from 300 000 hectares in the 1960s to between 70 000 and 100 000 hectares in recent years. Such severe reduction of the annual flooding extent has put the wetlands at risk and reduced the economic and environmental benefits they provide, including agriculture, cattle, fuelwood, fish, shallow aquifer recharge, and habitat for migratory and local bird species.

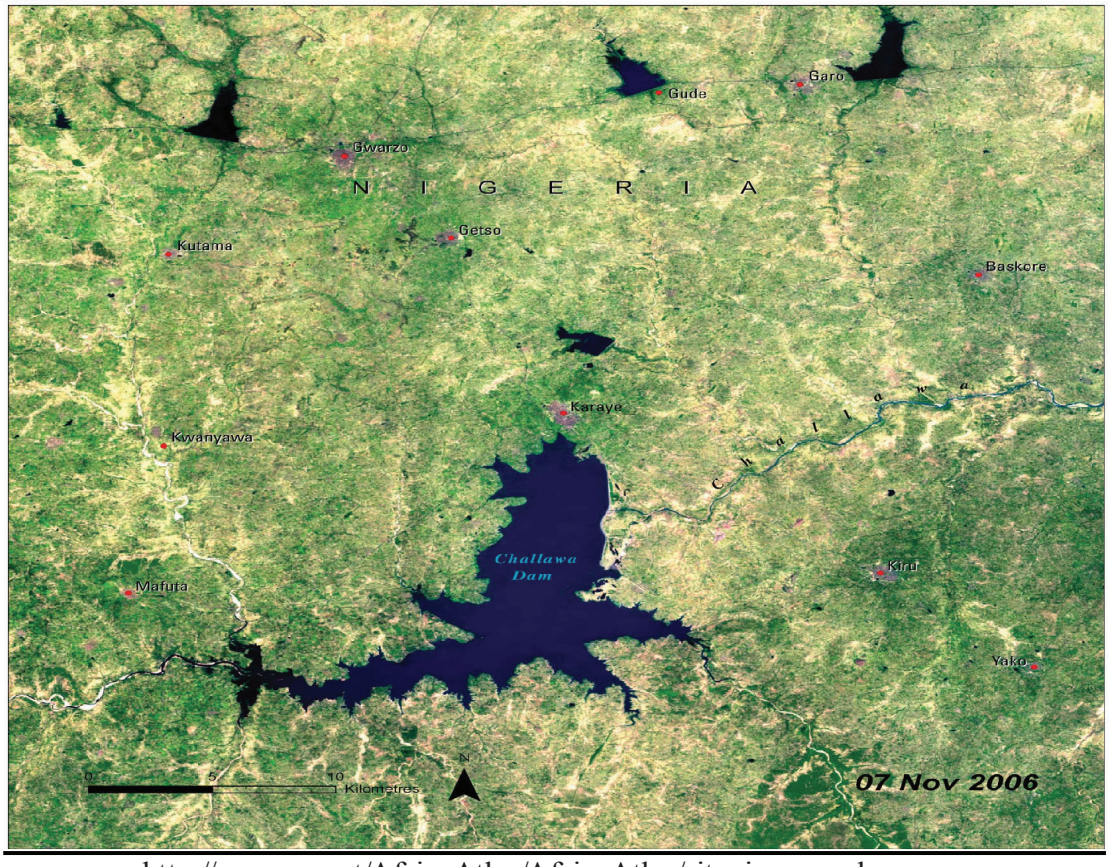
The economic impact of the Challawa Dam (and the Tiga Dam further upstream) has also been negative, eventually incurring millions of dollars more in losses than were yielded in benefits. In addition, while flood control was among the intended benefits of the dam, heavy rains often cause serious flooding above the dam.'

(http://na.unep.net/atlas/webatlas.php?id=162)

1990



2006



http://na.unep.net/AfricaAtlas/AfricaAtlas/site_images.php

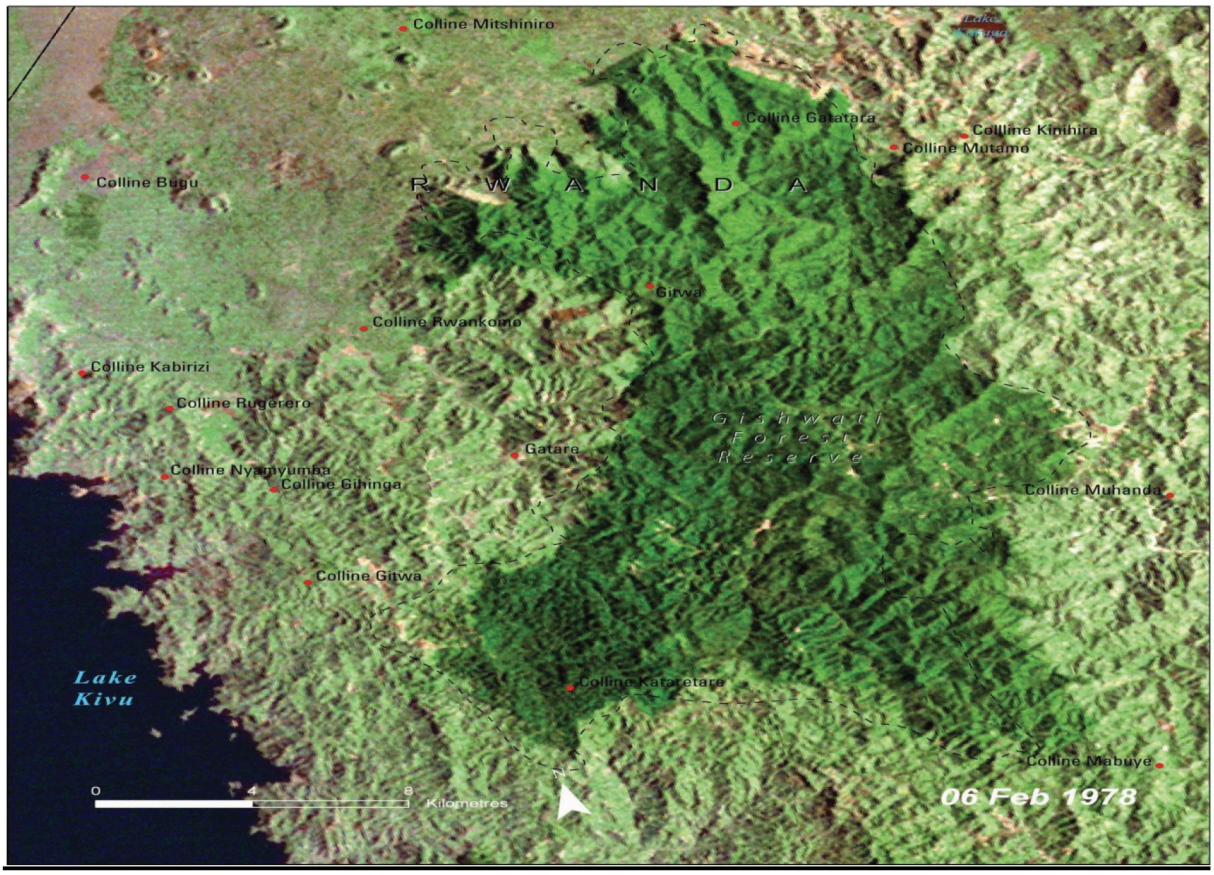
Dramatic Deforestation: Gishwati Forest, Rwanda 1978 and 2006

'Gishwati Forest Reserve in north-western Rwanda is one of the most severely deforested areas in the country. Exploitation of the forests for commercial products such as charcoal, timber, medicine, and food has been the main driver of this deforestation. The 1978 satellite image shows the Gishwati Forest Reserve as a dark-green carpet of dense forest nearly covering the entire protected area. The 2006 image shows that most of the forest has been cleared; patches of pink and light green have replaced the dark-green areas where the vegetation has been largely removed. Only a fraction of the forest that was intact in 1978 remains; what is left is in a degraded condition.

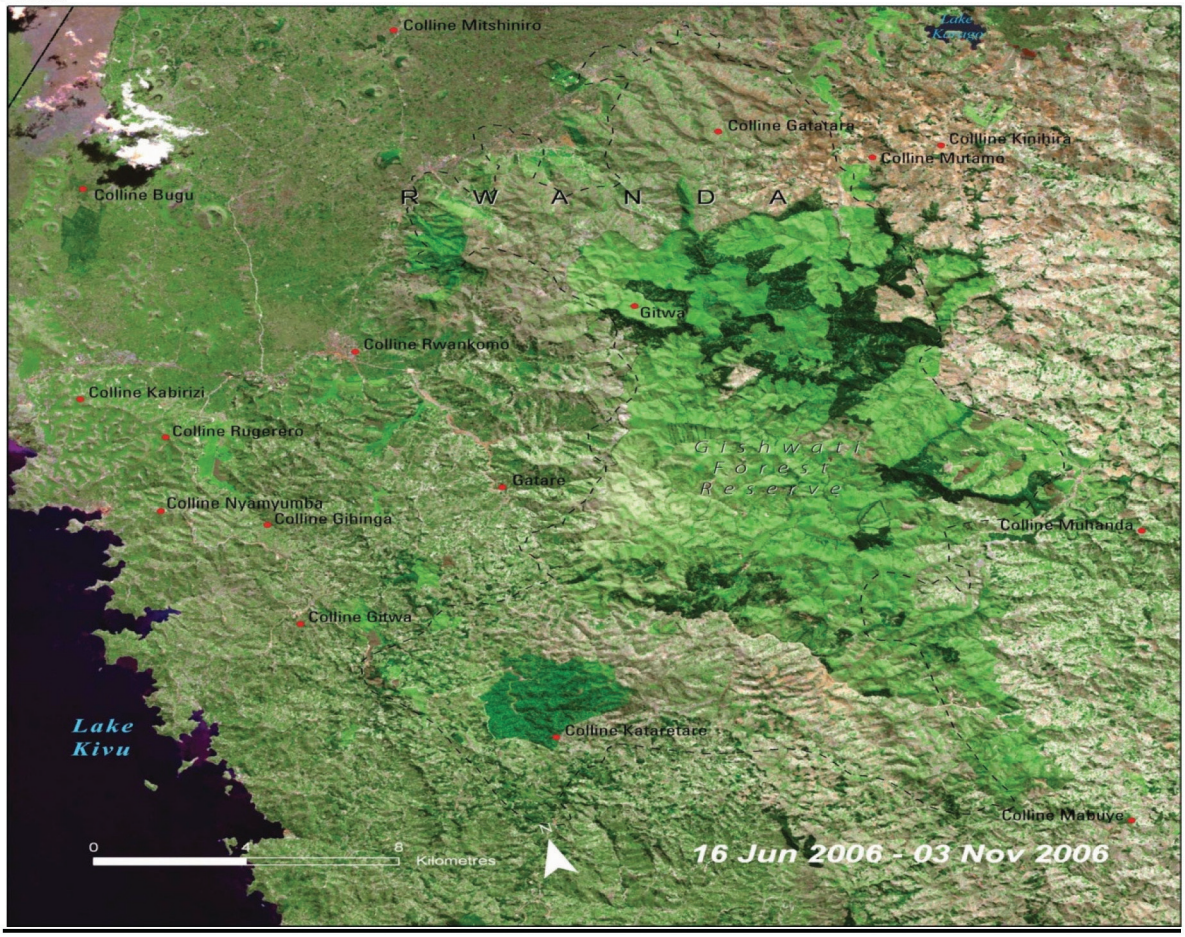
On a positive note, reforestation efforts in parts of the region, using agroforestry techniques such as radical terracing, progressive terracing, and live mulches, are currently being researched and implemented. Seedlings of species such as Calliandra calothyrsus and Leucaena diversifolia are being planted in several provinces of the country with collaboration from stakeholders and the local community. If such efforts continue and are successful, the Gishwati Forest Reserve may experience considerable regeneration within the next five to ten years. '

(http://na.unep.net/atlas/webatlas.php?id=280)

1978



2006



http://na.unep.net/AfricaAtlas/AfricaAtlas/site_images.php

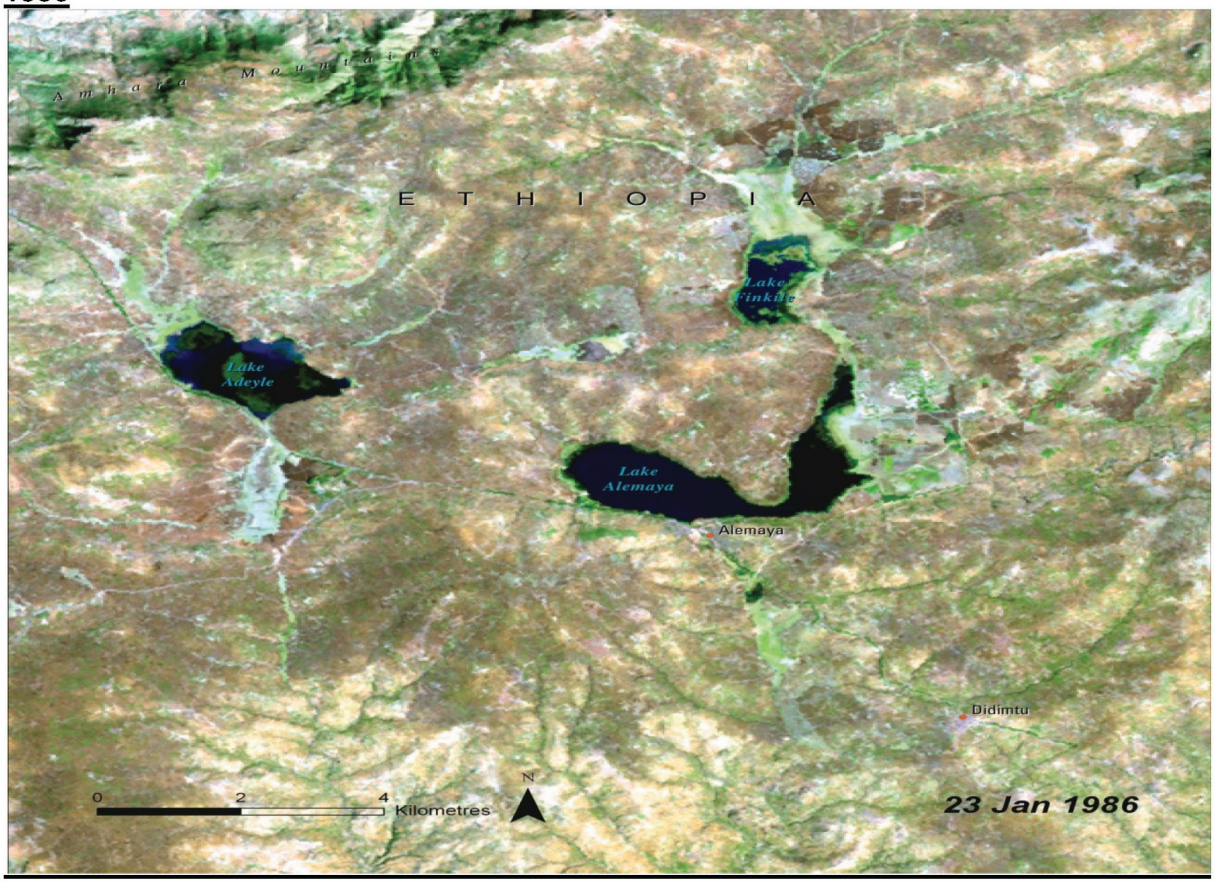
Shrinking Water Resources: Lake Alemaya 1986 and 2005

'Lake Alemaya in the Ethiopian Highlands has historically provided the surrounding area with water for domestic use, irrigation, and livestock and has served as a local fishery. As recently as the mid-1980s its maximum depth was around eight metres and it covered 4.72 km2. Since then Alemaya's water level and surface area have declined considerably, as is evident in these images. In recent years, low water levels have interrupted the water supply in Harar, a nearby town of over 100 000.

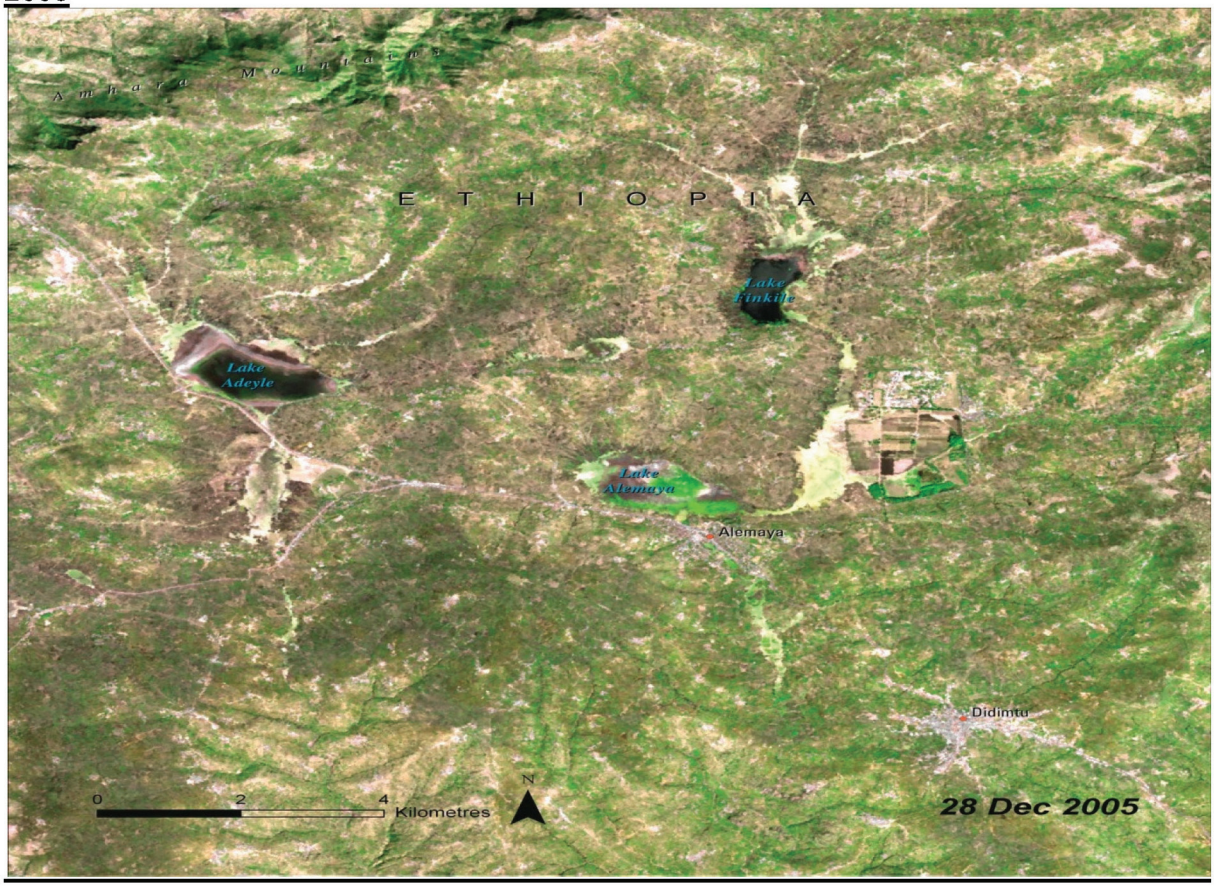
Increasing irrigation and domestic water use change in the local climate, and changes in the surrounding land cover are believed to be the causes of Alemaya's demise. Agriculture expanded dramatically starting in the mid-1970s due to improved infrastructure, increased population, and changes in government policies toward production and marketing. Among the crops grown is khat, a psychoactive leaf consumed heavily in northeastern Africa. Khat has become an exported cash crop in recent decades and irrigation has increased as a result. In addition, siltation caused by the deforestation of the Alemaya watershed has reduced the capacity of the shallow lake. A trend of warmer temperatures since the mid-1980s may also have increased the rate of evaporation from the lake.'

(http://unepatlas.blogspot.com/2008/06/lake-alemaya.html)

1986



2005



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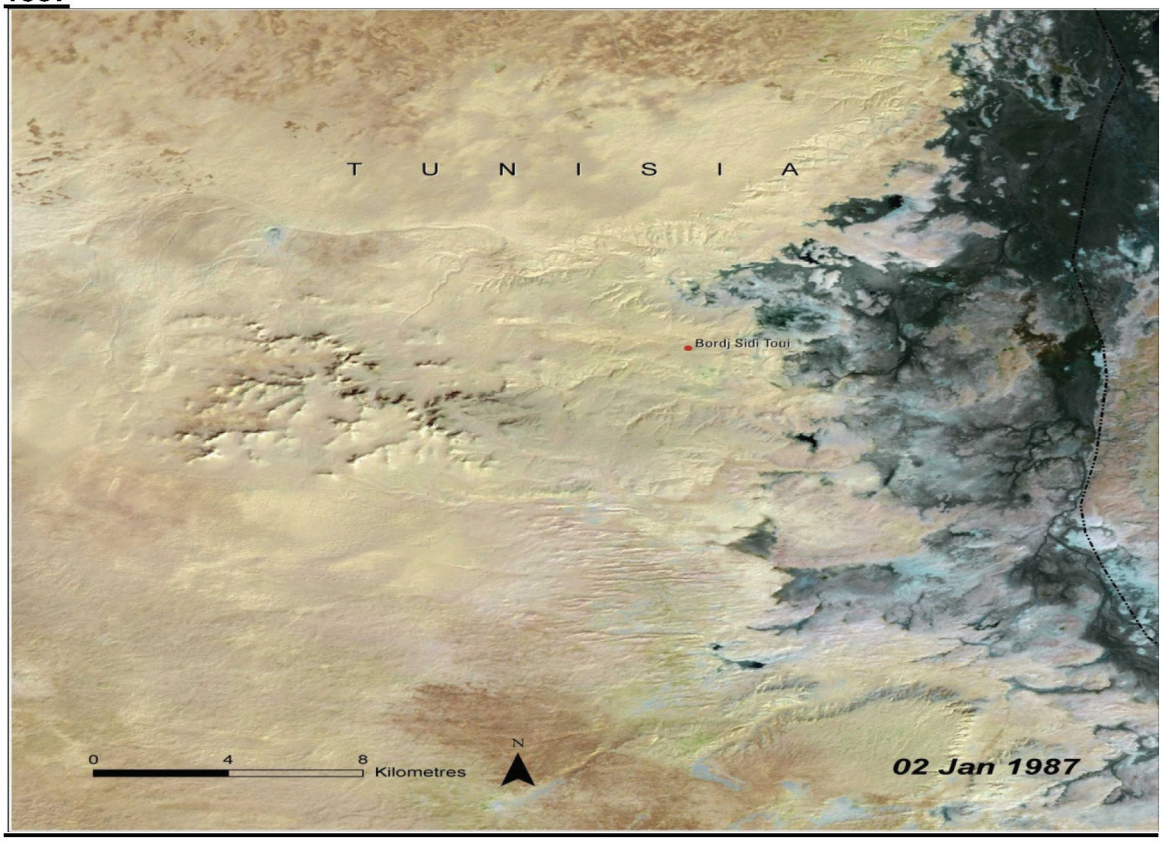
Habitat Regeneration: Sidi Toui National Park, Tunisia 1987 to 2006

'Habitat Regeneration: Sidi Toui National Park, Tunisia - 02 January 1978. The semi-arid Sahelian grassland and scrub of southern Tunisia has been profoundly altered by human activities during the last century. Located on the northern fringe of the Sahara Desert, this ecosystem is susceptible to erosion and desertifi cation brought on by droughts, overgrazing, and agriculture. In 1993, Sidi Toui National Park was established. Within the bounds of this protected area, natural vegetation began to return. The 1987 image shows the barren condition of the region before the park was created. In the 2006, image the outline of the park, which is protected from the effects of grazing cattle, contrasts markedly with the surrounding landscape. Protection substantially increased the vegetation density and species diversity, particularly of the grasses.

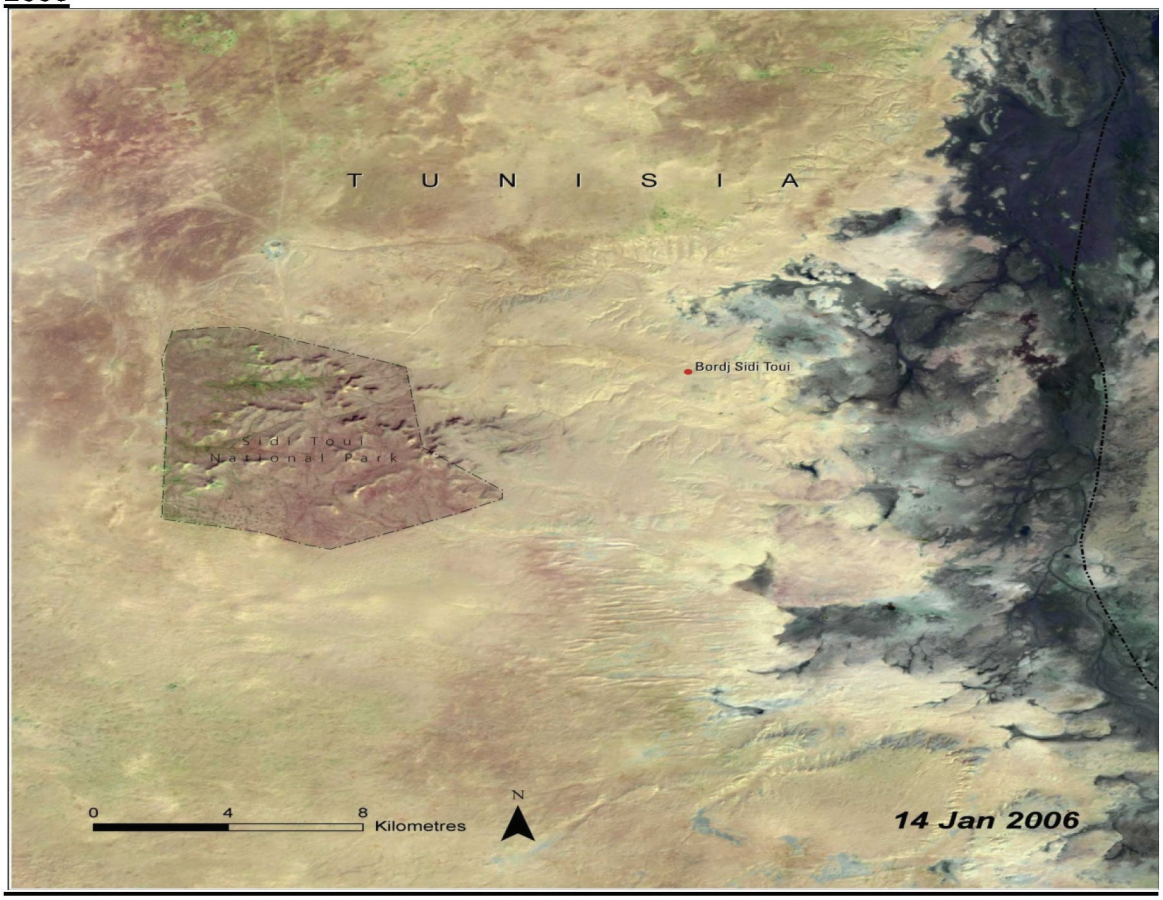
Habitat Regeneration: Sidi Toui National Park, Tunisia - 14 January 2006. The Scimitar-horned oryx (Oryx dammah) and five other species of gazelles and antelope native to this area had been brought to near extinction by lack of habitat and overhunting throughout the 20th century. Classifi ed as critically endangered in 1996, a small population of Scimitar-horned oryx was introduced into Sidi Toui Park in 1999. If the population inside the park thrives, it may enable future reintroductions of Scimitar-horned oryx elsewhere, Sidi Toui also provides habitat for several native species of antelope, as well as a variety of birds species.'

(http://www.unep.org/dewa/africa/africaAtlas/graphics/index.asp)

1987



2006



http://na.unep.net/AfricaAtlas/AfricaAtlas/site_images.php

Invasive Plants: Lake Chivero, Zimbabwe 1989 and 2000

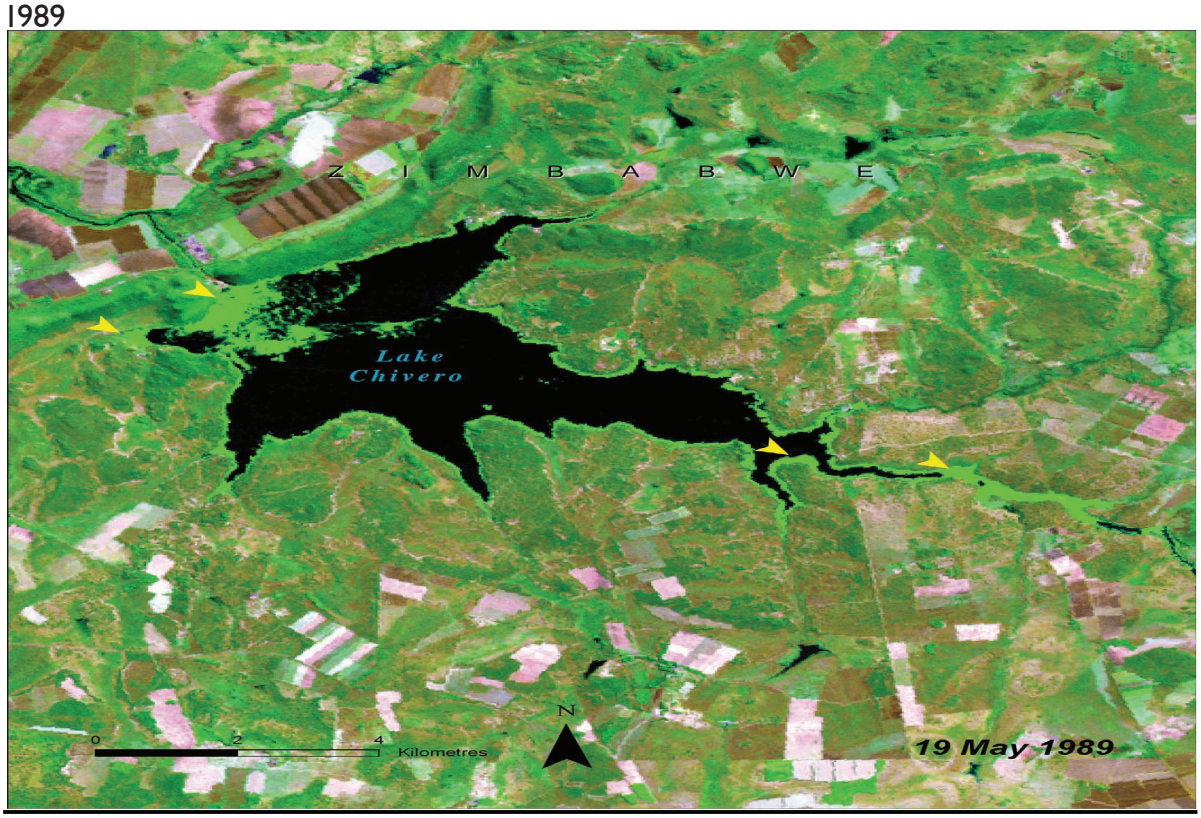
'In 1952, the Manyame River was dammed 40 km southwest of Harare, creating Lake Chivero. The Lake was intended primarily as a water supply for Harare, but it is also a source of water for irrigation and industry and serves as a local fishery.

One year after Lake Chivero was created, water hyacinth, an invasive wetland plant, made its first appearance, as a result of the influx of nutrients from nearby agricultural lands and municipal and industrial wastes from Harare. In 1955/1956, the first serious water hyacinth outbreak occurred and was successfully treated with chemical herbicides. The next outbreak in 1971/1972 covered approximately 25 per cent of the lake. Attempts to end a third outbreak in 1986 used mechanical and chemical controls until public concern about the chemicals brought an end to their use. By 1989, water hyacinth covered 20 per cent of the lake's surface (1989 image, yellow arrows); by 1990, it covered 35 per cent. Weevils that feed on water hyacinth were released as a biological control; mechanical and new chemical controls continued.

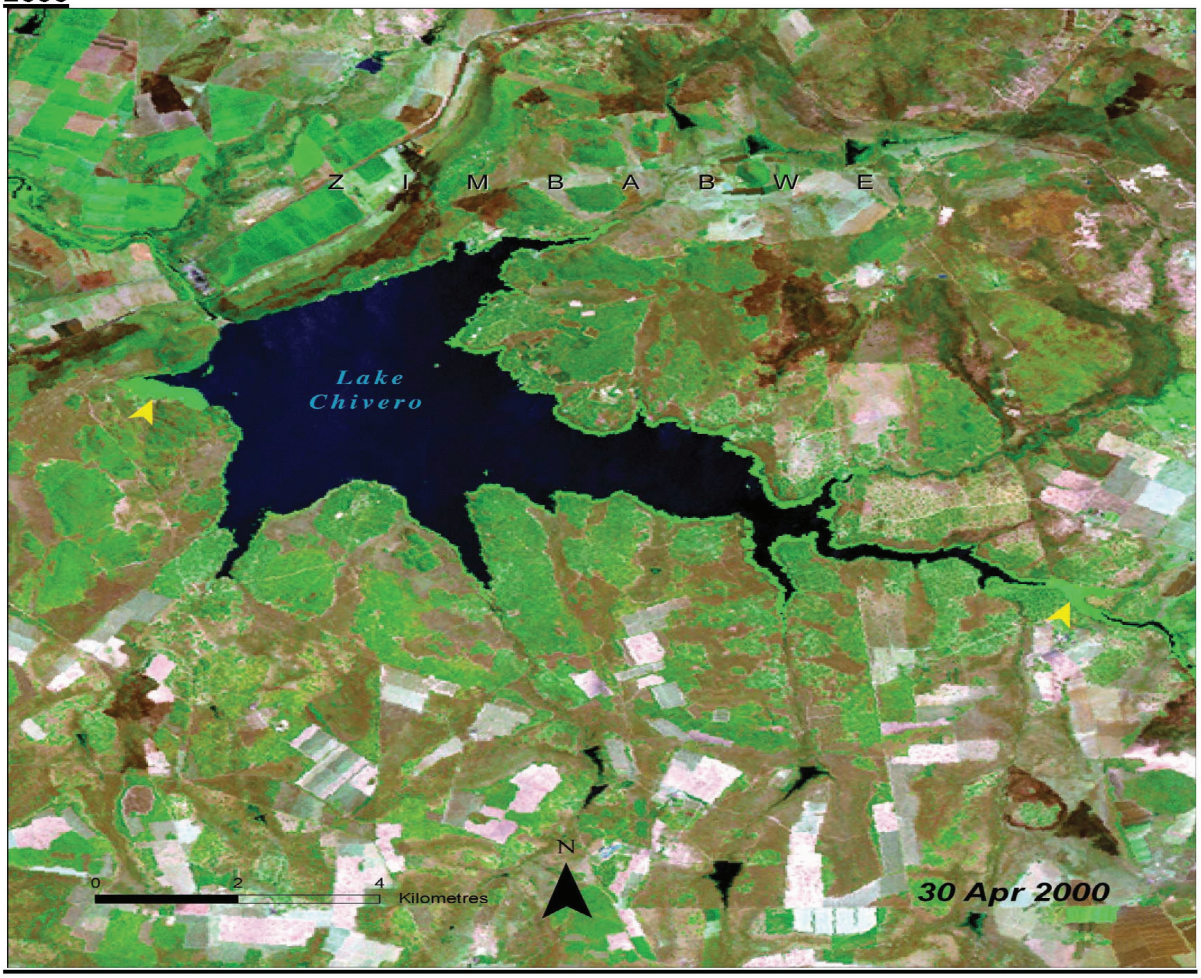
By 1997, it appeared that water hyacinth had been brought under control (2000 image, yellow arrows). By 2005, however, the invasive plants had returned again, reportedly covering as much as 40 per cent of the lake. In addition to water hyacinth, this most recent infestation includes massive amounts of another invasive plant, spaghetti weed (Hydrocotyle ranunculoides).'

(http://unepatlas.blogspot.com/search?q=chivero)

1989



2000



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