

Combating Desertification

‘What makes the desert beautiful
is that somewhere it hides a well’

The Little Prince, Antoine de Saint-Exupery

Cover pic: Dead Acacia trees, Namib Desert, Namibia, Africa.
Photo: Getty Images

Inside Cover pic: Mohammed Idris drawing water from a
covered well in Embulday, Anseba, Southern Eritrea.
Photo: Danny Rowan/Concern



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Introduction

The earth's soil is disappearing at an alarming rate. A thin layer of soil takes centuries to develop but can be blown or washed away in a few seasons. Desertification is a major concern because of the link between dryland degradation and a decline in food production.

- This Resource explores the definition of desertification; where it occurs; the causes, consequences and solutions and what we ourselves can do to alleviate some of the consequences.
- It revisits the Convention to Combat Desertification and how it interlinks with the United Nations Framework Convention on Climate Change and with the Convention on Biological Diversity – all three Conventions were born out of the 1992 Earth Summit.
- It concentrates mainly on the Sahel and Sub-Saharan Africa with some brief illustrations from other areas.
- The resource pack has been written for Geography teachers and both their Leaving and Junior Certificate Students.
- It includes student Worksheets and answers.
- It aims to complement the units on Geo-Ecology; Global Interdependence; The Dynamics of Population; and Patterns and Processes in the Physical Environment (II) External Forces.
- For the Junior Certificate Curriculum the resource is very relevant to: Primary Economic Activity; Economic Inequality; Climate and Natural Resources; Population Distribution, Diversity and Change and the Mali story.

Objectives

- To raise awareness of the problem of desertification.
- To show how desertification is a major impediment to the attainment of the Millennium Development Goals.
- To provide teachers with a solid educational foundation on the theme of desertification.
- To encourage teachers and students to act locally to combat desertification.
- To demonstrate that desertification, although a serious problem, can be tackled.

DISTURBING FACTS

In Nigeria, overgrazing and over-cultivating are converting 351,000 hectares of land into desert each year.
www.earth-policy.org

250,000 hectares are being lost each year in Niger through desertification. This is equivalent to an area about the same size as Luxembourg.

The Worldwatch Institute estimates that the earth's landmasses are losing as much as 24 billion tons of topsoil every year.

One third of the world's land is covered by dryland ecosystems.

70% of the 5.2 billion hectares used for agriculture around the world are already degraded.

Desertification and drought affect approximately one billion people and 25 % of the earth's total land surface.



Human activity puts 6 billion tons of carbon dioxide (CO₂) into the atmosphere each year.

The 2002 drought in Australia was the worst in more than a century, blowing away millions of tons of productive topsoil in dust storms and crippling crop production and exports.

During the 1960s there were 16 climate-related disasters. During the 1990s there were 70.

The five warmest years over the last century occurred in the last eight years. The warmest year was 2005, then 1998, 2002, 2003 and 2004.
– NASA GISS

More than 8000 tree species, 10% of the world's total, are threatened with extinction.

Section One

PURPOSE

After completing this section students will have explored;

- the concept of desertification
- the main areas where desertification occurs
- the main causes of desertification
- the indirect causes of desertification

What is desertification?

Desertification is defined by the United Nations as 'land degradation in arid, semi-arid and sub-humid areas resulting from various factors including climatic variations and human activities'.

Using the ratio of *mean annual precipitation* to *mean annual potential evapo-transpiration*, the world is divided into aridity zones.

Arid, semi-arid and sub-humid areas are referred to as drylands and are defined by:

- Low rainfall that is infrequent, irregular and unpredictable



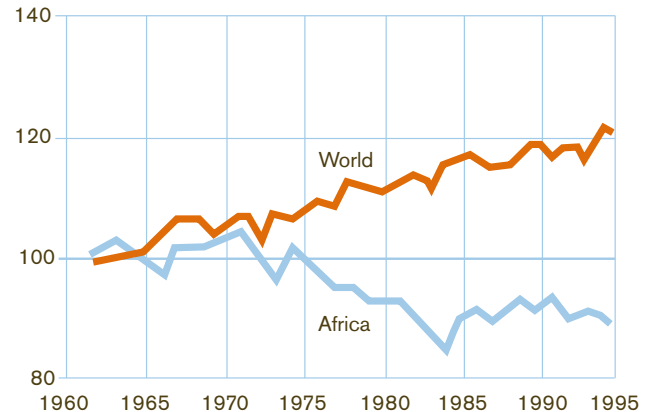
- Soil that is low in organic matter
- Lack of water for consumption

These characteristics make drylands vulnerable to erosion. The agents of erosion are water and wind and these remove the topsoil first. Once this nutrient-rich layer of topsoil is gone, few plants grow in the soil. This loss of the biological potential of land is called desertification.

The link between desertification and hunger and poverty means that urgent solutions to this global problem must be found. If desertification is not stopped and reversed, per capita food yields in many affected areas will continue to decline.

Per capita food production

index numbers 1961=100



Source: WRI, UNEP, UNDP and WB 1998

Where does desertification occur?

The world's drylands are mainly found in:

- two belts centred on the Tropics of Cancer and Capricorn
- the North American Great Plains and parts of Central Asia which are both in the rain shadow of mountains
- some European countries, particularly those near the Mediterranean

More than 110 countries have drylands potentially at risk.

The impacts of desertification vary from place to place. Although the United States has the highest percentage of drylands at 74%, Sub-Saharan Africa, because of its dependence on land, is more deeply affected.

In Kenya, around 80% of the land surface is threatened by desertification. In 2005, Concern, in partnership with the Diocese of Malindi, Kenya, provided seed and technical support to 2,129 farm households who were severely affected by drought.

"A nation that destroys its soil, destroys itself." – President Franklin D. Roosevelt



The “Dust Bowl” disaster in the states of Kansas, Oklahoma, Texas, Colorado, and New Mexico which lasted throughout the 1930’s caused immense hardship then. Farming communities faced depopulation, and farming families faced starvation.

John Steinbeck’s novel *The Grapes of Wrath*, is set against the background of Dustbowl Oklahoma and Californian migrant life.

“Highway 66 is the main migrant road...the path of a people in flight, refugees from dust and shrinking land...from the desert’s slow northward invasion... from the floods that bring no richness to the land”

Deserts expand and shrink with changes in rainfall. Satellite imagery has shown that the vegetation boundary south of the Sahara can move by up to 200 km when a wet year is followed by a dry one, and vice versa. This gives some hope that with favourable climatic and land-use conditions some degraded land could be revived.

What causes desertification?

Desertification is due mainly to climate variability and unsustainable human activities.

Human activities

Four human activities which are significant contributory factors in the process of desertification are

1. **overgrazing** which removes vegetation cover;
2. **overcultivation** which exhausts the soil;
3. **deforestation** which destroys the trees that protect the soil; and
4. **poorly drained irrigation systems** which turn croplands salty.

1. Cause: Overgrazing

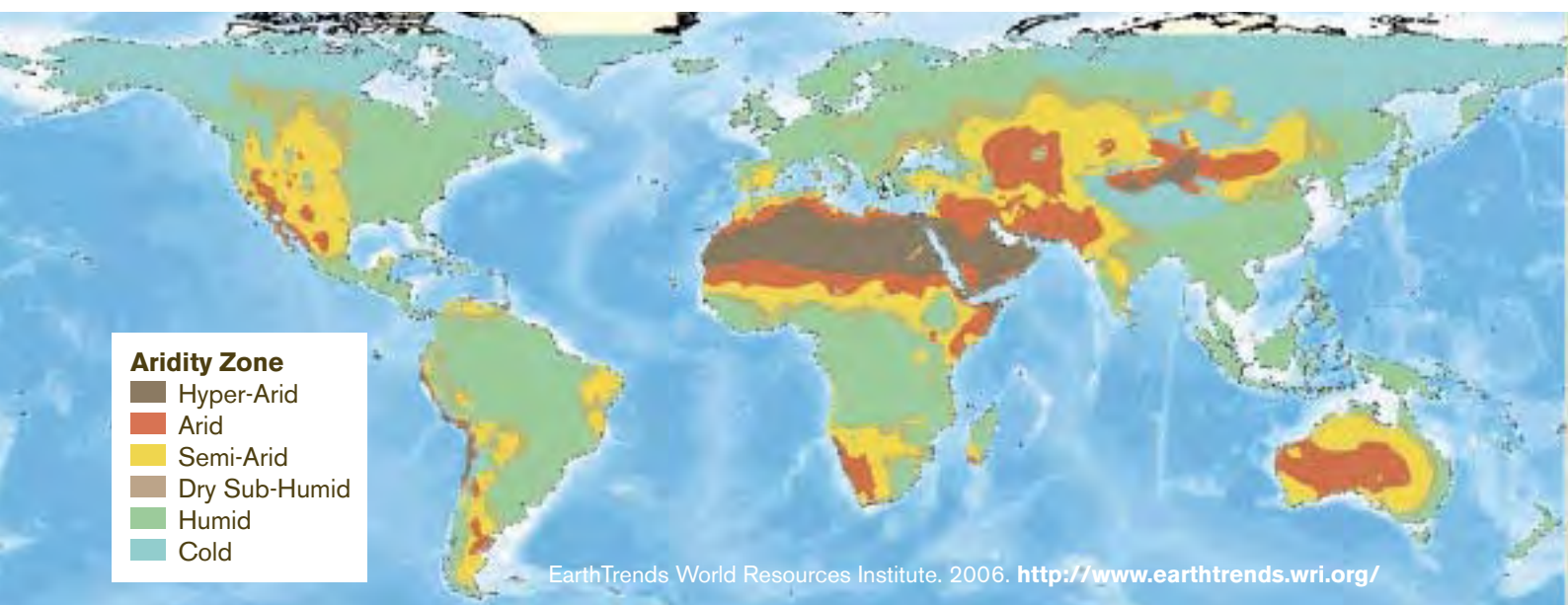
When soil is stripped of its vegetation and compacted by excessive numbers of cattle, it loses its ability to support plant growth and to hold moisture. In dryland pastoral economies, large numbers of stock build up during periods of above-average rainfall, too many to be supported through a drought. By the time dryland pastures are overgrazed to a stage that threatens regeneration, prices for livestock usually have decreased because of a saturated market.

Some African nations view nomadic pastoralism as a backward system and promote sedentary farming. In Eritrea the land-tenure system was insecure making the promotion of agro-forestry and other farm activities unviable.

Under the 1994 Land Reform Proclamation*, the Eritrean Government now distributes land to the villagers who get usufruct rights to a piece of land for their lifetime. However the interests of the pastoralists have been overlooked because when a system of enclosure becomes widespread the nomadic pastoralists become hemmed in by sedentary farmers.

2. Cause: Over-cultivation

Dryland crop farmers have a tendency after a period of good years to extend their cropping onto more marginal lands, which are only suitable for grazing. This places nomadic pastoralists at a disadvantage. In Nigeria, overgrazing and over-cultivating are converting 351,000 hectares of grassland and cropland into desert each year. The conflict between farmers and herders in Nigeria is a struggle for survival. www.earth-policy.org



3. Cause: Deforestation

In Niger, the exploitation of trees for fuel has proved more lucrative than traditional agricultural activities. Firewood destined for Zinder town is collected up to 200 km away.

Deforestation leads to a loss of fertility through soil erosion and runoff. The soils become shallow and of low fertility and the water-holding capacity of the soil decreases. This also results in rivers flooding excessively after a downpour, but quickly running dry. 82% of the total energy used in the Sahel comes from wood. As the supply decreases rural people who used to enrich farmlands with animal manure now use the manure for fuel. This is causing impoverishment of soil resources.

The Sahel is the semiarid ecological zone between the Sahara and the savanna lands to the south and includes parts of Mauritania, Senegal, Mali, Burkina Faso, Niger, Nigeria, Chad, Sudan and Ethiopia.

Eritrea is a very poor country. For centuries, the natural flora of Eritrea have been important to the local communities as a source of fuelwood, wood for house construction, fruits, food and medicines. Wars, recurrent droughts, mismanagement during colonial rule, and, more recently, over-exploitation by the local people have resulted in a huge decrease in these resources.

The largest share of forest exploitation now lies with tree cutting for fuelwood, followed by timber cutting for construction poles. A typical traditional highlands home (*Hidmos*) takes about 100 poles for its construction, that means the felling of 100 live trees.

Forest and bush fires are another problem. These fires prevent the natural regeneration of trees and they can spread into the nearby forest or woodland.

Fire is used:

- to clear additional land for cultivation
- to chase wildlife away from livestock
- to clear grasslands before the rainy season so as to encourage the growth of palatable green grass

Every minute of every day an estimated 26 hectares of forests, roughly the size of 37 Croke Parks, is lost worldwide due to agricultural pressure, road building, forest fires and illegal logging.

4. Cause: Irrigation systems

Salinization occurs in irrigated cropping systems when evaporation removes the water from waterlogged soils and leaves increasing salt levels in the soil. This build up of salts makes soil less fertile.

Indirect causes of desertification

5. Indirect cause: Loss of traditional knowledge

The loss, or non-application, of indigenous knowledge has resulted in land degradation in many countries. In the past the inhabitants of drylands responded flexibly to climate conditions.

- The driest lands were reserved for nomadic herding.
- Rainfed crops were cultivated where there was more than 350-400mm of rainfall.
- Different crops were sown to reduce risk of a complete crop failure.
- Pastoralists and sedentary farmers had a symbiotic relationship bartering meat and milk for cereal and legumes.

Indigenous Knowledge

The Mongolian tribes had a gentle ecological presence. They kept large herds of goats, sheep and horses, but they understood the fragility of their land which was vulnerable to sun, wind and drought. They preserved the grass by moving their herds regularly, allowing the grazed areas time to recover. Oases, forests and areas of fixed sand formed natural barriers against the deserts.

In the 19th century the Qing Dynasty rulers encouraged Han farmers to settle in the region and plough up areas of grassland for the cultivation of grain. The influx continued and Mongolians now account for only about 20 per cent of the population. The rising numbers of people and animals, and the shift from nomadic pastoralism to agriculture, led to an increased demand for water and the cutting down of the forests for firewood.

http://www.smhric.org/Latest_B.htm

* The Eritrean approach: Land tenure legislation promulgated in 1994 reflects a strong policy of gender equality. The right of ownership of all land in Eritrea is the exclusive right of the government. Every Eritrean citizen, whose main source of income is the land, qualifies automatically for land regardless of sex, religion or marital status; individual holdings are registered and lifetime usufructory title-deeds issued. Source: *Proclamation to Reform the System of Land Tenure in Eritrea, No. 58/1994*.



6. Indirect cause: **Cash Crops**

The need for foreign exchange to pay debts meant that the bartering system was no longer an adequate economic system. This led to an increase in cash crops. The increased cultivation of cash crops for export has resulted in:

- the expansion of cropping onto marginal land.
- a tendency towards monoculture - which lowers agricultural biodiversity and causes soil degradation. In the twentieth century 75% of all agricultural plants cultivated by previous generations became extinct.
- an inflexible response to climate conditions due to production schedules of large corporations.
- short-term exploitation of local resources which often leaves little profit at the community level for caring for the land.

Cash crops are not confined to food crops.

- Flower farms and other non-food crops, such as cotton, also exploit land where food could grow.
- They can block the migration routes of pastoralists and access to natural resources.
- Flowers are a water-hungry crop, a large flower company consuming as much water as 20,000 people.

In Niger peanut exports increased rapidly until 1970 but then declined due to lower prices and the appearance of a disease. Millet cultivation replaced peanuts. Now the land used for millet cultivation has become barren sand dunes. 250,000 hectares are being lost each year in Niger through desertification.

Niger is a low-income, food-deficit country, and ranked 176th out of 177 countries in the United Nations Development Programme's Human Development Index (HDI) 2004.

In the Mediterranean region intensive olive cultivation is degrading the soil. Up to 80 million tons of topsoil is lost every year from olive plantations in the Spanish region of Andalucia alone. The olive subsidy is an example of an EU farm subsidy, which can harm rather than enhance the environment. www.wwf.org.uk

Over-exploitation of soil happens through:

- Crops cultivated in areas at high risk from drought
- The reduction of fallow periods
- Inadequate crop rotation
- Monoculture
- Crops being cultivated along a downward sloping face rather than following the natural contour lines

Fallowing is a practice of allowing a field to rest between cropping. A natural ground cover can protect, fertilize and improve the structure of the soil and can be grazed on by livestock and then ploughed back into soil.

Crop rotation is the practice of growing a series of dissimilar crops in the same space in sequential seasons. Crop rotation balances the fertility demands of various crops to avoid excessive depletion of soil nutrients. Crop rotation can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants.

7. Indirect cause: **Poverty**

Desertification is both a cause and a consequence of poverty. Poor people often farm degraded land that is unable to meet their needs. Their poverty gives them little choice but to extract what they can from the scarce resources available to them, even though this degrades the land further. When the land becomes too degraded, these poor people are often forced into internal and cross-border migrations, which can further strain the environment and cause social and political tensions.

Kofi Annan explained "Nowhere is the problem of desertification more acute than in Sub-Saharan Africa, where the number of environmental refugees is expected to rise to 25 million in the next 20 years."

8. Indirect cause: **Population growth**

In the Chapter on The Dynamics of Populations some interesting facts on population can be seen. Total global population in 1960 was 3 billion. By 2004 the figure had more than doubled 6.4 billion.

Africa had only 7% of the population in 1930. By 2004 it had 15%.

The population of the Sahel increased from 274 to 628 million between 1968 and 1998 with the rural population growth being 2% and the urban population growth being 5%. www.drylandsresearch.org.uk

One of the consequences of desertification in Kenya is a constant flow of rural poor to Nairobi. The population of Nairobi has grown by 800% from 350,000 in 1963 to 2,818,000 in 2005 (National Geographic September 2005).

Population growth combined with bad land management can lead to desertification. People cut down trees for fuel and try to get as much food as they can from decreasing arable land.

A decline in population can also result in desertification since there may not be enough people to manage the land in a sustainable way.

A study of the semi-arid Machatos district in Kenya revealed that, despite an almost six-fold increase in the population between 1930 and 1990, the Akamba people succeeded in increasing productivity on both a per hectare and a per capita basis, while controlling and even reversing the degradation of natural resources. This was achieved through farmer led innovations in terrace construction.

Population pressure can be indirect:

- growing urban populations place demands on food production in rural areas
- the cultivation of cash crops for export have the same effect

In Kenya, 80% of the land is affected by desertification, and there is a constant flow of rural poor into Nairobi. Yet there is constant flow of heavily packaged Munge Beans coming all the way from Kenya to Irish supermarkets.

9. Indirect cause: Gender Bias

Men have disproportionate access to land and credit. They are encouraged, through development strategies, to plant cash crops for income—often on land on which women had formerly grown food. Gender bias keeps population growth rates high, because it denies women routes to economic security other than childbearing.

Jodi L. Jacobson, Worldwatch Initiative



Dorothy Kalenga (aged 9) with food produced under a Concern programme, Angola. Photo: Danny Rowan/Concern

Through Concern's Food Security programme in Angola, women's groups who grow crops for consumption are provided with seeds, training and advice.

Climatic factors

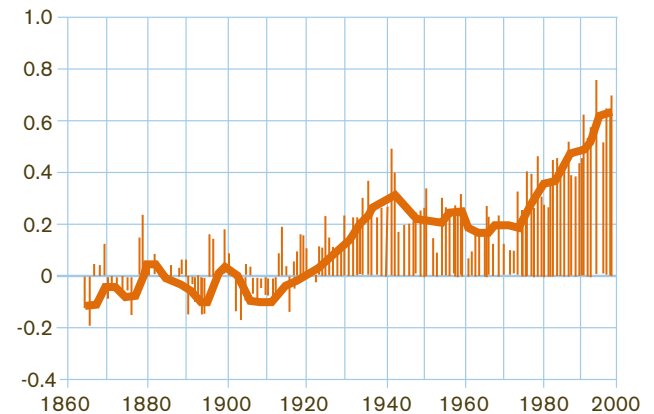
Human activity puts 6 million tons of carbon dioxide (CO₂) into the atmosphere each year – that is one tonne for each person on the planet. Ireland's rate of CO₂ emissions is 10 tons for every person in the country.

The five warmest years over the last century occurred in the last eight years. The warmest was 2005, then 1998, 2002, 2003 and 2004.

Snow cover is down 10% in the last 40 years.

Variations in global near-surface land temperature

Temperature variation in degrees C



Source: Hadley Centre

Global warming brought about by increasing greenhouse gas* levels in the atmosphere is expected to increase the variability of weather conditions. Greenhouse gases act like a blanket around the planet, stopping energy escaping from the Earth's surface and atmosphere.

- A decrease in the amount of rainfall in drylands would make more land vulnerable to desertification.
- High temperatures, combined with low rainfall, lead to the drying up of water resources and to droughts.
- Crops and natural vegetation grow poorly in times of drought, forcing people to crop and graze the land more to compensate for lower yields. This destroys vegetation even further.

Lloyd Timberlake, author of *Africa in Crisis*, stated, Africa has "taken too much from its land. It has overdrawn its environmental accounts," and the result for much of the continent has been "environmental bankruptcy."

* The main greenhouse gases are carbon dioxide, methane and nitrogen oxide. Carbon dioxide is produced by the burning of fossil fuels, such as coal, oil and wood, and by changes in land use such as the clearance of forests.



? QUESTION SHEET SECTION ONE

1) Briefly describe desertification.

2) Locate the main areas in the world where drylands are found.

3) How many countries have drylands which are potentially at risk? _____

4) What are the main causes of desertification?

5) List three major causes of forest exploitation in Eritrea.

6) Identify the role of climatic conditions in the process of desertification.

7) How much rainfall is necessary for the cultivation of rain-fed crops?

8) What is salinization?

9) Explain the practice of fallowing.

10) In the past the inhabitants of drylands learned to respond flexibly to climate variations.
Explain how they did this in two sentences.

11) List one reason for desertification in Spain and Italy.

12) Name one factor which led to an increase of cash crops in areas vulnerable to desertification.

13) Desertification is both a cause and a consequence of poverty.
In two or three sentences give reasons for this statement.

14) Explain how erosion and droughts are serious threats to water availability.

Section Two

PURPOSE

After completing this section students will have explored;

- some of the consequences of desertification
- what can be done about desertification through looking at different solutions
- seven approaches for combating desertification and achieving more sustainable land-uses
- the Convention for Combating Desertification; the World Day to Combat Desertification and Drought

What are the consequences of desertification?

The consequences of desertification are mostly borne by the world's poorest and most vulnerable people. Desertification contributes to food insecurity, water scarcity, economic hardship and social and political unrest.

- 24 billion tons of topsoil lost every year
- Decline in Food Production
- Poverty
- Unattained Millennium Development Goals
- Migration
- Flash Floods
- Economic Loss
- Loss of Cultural Identity

Loss of topsoil results in a decline in food. A **decline in food production** results in Hunger, Poverty and Migration.

The persistence of **Hunger, Poverty and Migration** is an obstacle to the attainment of the **Millennium Goals** – the first one being the eradication of extreme hunger and hunger.

The eight Millennium Development Goals (MDGs) – which range from halving extreme poverty to halting the spread of HIV & AIDS and providing universal primary education, by the target date of 2015 – form an agreed blueprint to meet the needs of the world's poorest. <http://www.un.org/millenniumgoals/>

Loss of water Without trees and vegetation occasional flash floods carry the soil away leading to downstream flooding. The surface water is then rapidly lost through evaporation and rivers and lakes disappear. The evaporation combined with sedimentation in lakes, rivers, and reservoirs means a loss of water as well as a loss of the soil displaced there.

Economic Loss At the global level, it is estimated that the annual income foregone in the areas immediately affected by desertification amounts to approximately US\$ 42 billion each year.

Loss of cultural identity and difficult living conditions for migrants undermines social stability. In Africa, many people have become internally displaced or forced to migrate to other countries. In the 1930's the same situation arose for the Californian migrants.

What can be done about desertification?

"The human community faces an array of choices about the quality of our lives and the state of the global environment. Each of those choices will help to determine what kind of world our children and grandchildren will live in".
Kofi Annan, UN Secretary General.

Measures to combat desertification should have human and social objectives. Here is a checklist of how to achieve more sustainable land-uses.

- ☒ Raising awareness of the problem
- ☒ Planting indigenous trees and shrubs
- ☒ Developing sustainable agricultural practices
- ☒ Using renewable energy
- ☒ Mobilizing and involving people
- ☒ Empowering women
- ☒ Developing rural markets

Solution: Raising awareness of the problem

Convention to Combat Desertification

The Convention to Combat Desertification was adopted on 17 June 1994 and in commemoration of this event "World Day to Combat Desertification and Drought," is observed every year on 17 June.

The purpose of the World Day is to raise awareness of desertification and to encourage actions that would remedy some of the consequences of desertification and prevent further degradation and loss of soil and water. At the 2002 World Summit on Sustainable Development, the Convention to Combat Desertification was singled out as a key instrument for poverty eradication in dryland rural areas.



The degradation of drylands is hindering efforts to overcome poverty and hunger and if not reversed will impede the attainment of the Millennium Development Goals.

The declaration of 2006 as the International Year of Deserts and Desertification (IYDD) highlighted the concern about desertification. All countries were encouraged to undertake special initiatives to mark the Year and through these efforts to raise awareness of desertification.

The International Film Festival entitled 'Desert Nights - Tales from the Desert' in Rome in December 2006 is an example of one such awareness-raising initiative.

Solution: Planting and protecting indigenous trees and shrubs

The benefit of trees is enormous when it comes to preventing desertification or restoring already degraded land.

The first step in halting desertification is usually the planting of trees to:

- stabilise the soil
- protect it from excessive sunshine, strong winds and the progression of sand
- intercept the rainfall and protect the soil from splash erosion
- retain moisture and help local recycling of rainfall – water trickles down through the canopy and is absorbed by the humus layer
- replenish soil nutrients
- absorb carbon dioxide

The over-exploitation of indigenous trees and the introduction of non-native species can lead to ecological disturbance.

Indigenous trees and plants have special adaptations to local situations and benefit local wildlife. In Ireland, for example, the Oak tree can host up to 400 different insects and it is the climax vegetation in the Irish oakwood ecosystem. The introduction of Rhodendrum has upset this balance in some native oakwoods. In drylands woody desert trees, such as acacias, evade drought by shedding their leaves as the dry season sets in. Many dryland species have deep taproots that explore deep underground water layers and many are leguminous* species which improve soil fertility.

Regeneration of endangered indigenous species is important. One method of encouraging natural regeneration is through the establishment of

temporary enclosures. It is essential that this plan is in harmony with the wishes of the users. Another method is the establishment of seed or gene banks, places where seeds are stored for short-term use in farming or for long-term preservation.

When attempts to introduce exotic species into Tunisia as a way of improving degraded soil were unsuccessful attention turned to indigenous pastoral plants. A gene bank of indigenous arid and desert rangeland plant species was created in the Arid Regions Institute in Tunisia in 1986. This gene bank has been included within the national programmes to combat desertification and the national programmes for biodiversity.

Community Forests

The objective of community forestry is to meet the needs of people in a way that is sustainable by making forest products available to them. Local people gain rights to use and manage the forest for their own benefit. The community projects can also include roadside planting, and planting around homesteads, schools, hospitals, churches, mosques, sacred areas, parks and riverbanks. The involvement of schools helps to raise awareness of tree planting.

Trees and shrubs while playing an important role in improving soils, protecting watersheds, reducing salinisation and modifying climate are also producing food and high-value forest products for local communities.

In Gambia the communities benefits from 85% of forest revenues and the Forestry Department receives 15% which is reinvested through National Forestry Fund.

In a Concern programme in Afghanistan 132,428 trees were distributed protecting about 800,000 square metres of land. 30,339 fruit trees provided food and livelihoods.

Solution: Developing sustainable agricultural practices

By increasing the number of trees in agricultural areas, farmers live in harmony with their environment. The land benefits from the farmers' presence and the farmers benefit from their own control of desertification.

Agroforestry is a practice which integrates high-value multi-purpose trees and shrubs into farming systems. Agroforestry systems include alleycropping**, windbreaks, riparian buffer strips, and forest farming.

* **Nitrogen-fixing bacteria** (Rhizobium) attach to the roots of legumes. The plant supplies carbon compounds to the bacteria, and the bacteria convert nitrogen (N₂) from air into a form the plant host can use.

** **Alleycropping** is the inter-cropping of trees and crops simultaneously. The deep roots of the trees minimize below-ground competition with crops, enabling these systems to be ecologically sound and economically viable.

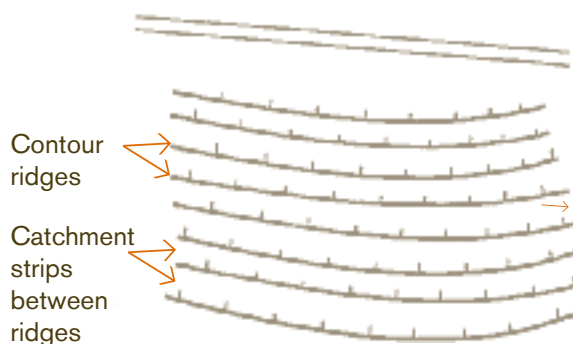
The trees shelter land and livestock, provide wildlife habitat and control soil erosion. Leguminous species improve soil fertility, fruit trees provide nutrition, trees, like the Acacia Senegal, provide gum and medicine and different palatable trees provide fodder.

Riparian buffer zones are areas of forested land adjacent to streams, rivers, marshes or shoreline, which help to prevent erosion and sedimentation. They also keep the river cool and this helps to lessen evaporation.

Trees that are fed to or browsed by animals should provide protein, vitamins and mineral elements which are frequently lacking in grassland pastures during the dry season. The *prosopsis* species which are highly drought resistant has pods which are rich in protein and make good livestock fodder. www.fao.org/

Bunding, contour bunding and terracing are techniques for halting erosion. With bunding grids of earth mounds enclose areas of land, preventing runoff and allowing rainwater to percolate down to replenish the water table and preserving what is left of the topsoil. Physical structures, such as bunds, should be complemented by other approaches such as the use of manure and rotation with leguminous crops to enhance the fertility of the soil.

Contour ridges: field layout



Examples of contour bunding for tree planting from Baringo District, Kenya.

Contour bunds for trees



In Eritrea Concern's activities to conserve soil and water include terracing, construction of gully checks and support for nursery and forestry.

Solution: Using alternative sources of energy

Sustainable energy use means ensuring enough energy supply for present and future generations, while at the same time protecting the environment. This can be done by using renewable sources of energy, and by being more careful about energy use.

Fast-growing, drought- and salt-tolerant, and with remarkable coppicing power, *prosopsis* is a natural fuelwood in arid and semi-arid areas. The wood has been called "wooden anthracite", because of its high heat content. The pressure on natural vegetation cover can be reduced through the development of alternative sources of energy and through improving the efficiency of existing energy use. Improved ovens with slow-burning wood are one way to save energy. In Eritrea Concern promoted the use of fuel saving stoves, known as mogogos.

Coppicing is the art of cutting of trees and shrubs to ground level allowing vigorous regrowth and a sustainable supply of timber for future generations.

Solution: Mobilizing and involving people

The Convention stresses that people who suffer the impact of desertification, and who best understand the ecosystems in which they live, must be involved in decisions about how to restore damaged land and prevent further degradation.

The Convention calls for the building of partnerships comprising affected populations and their representatives, the national government, and bilateral and multilateral donors. The purpose of the partnerships is to develop National Action Programmes to tackle the problem of desertification.

The Convention states that traditional and local technologies and know-how should be protected. Local populations should benefit directly from any commercial use of their techniques.

Over the years local populations in Africa have developed techniques for managing soil and water, domesticating plants and animals, and for forecasting the weather. Technical innovations are often brought in from more humid environments without regard for the equilibrium of dryland ecosystems.



Drylands comprise a wide variety of biophysical, economic and social settings. Therefore different sets of remedies to combat desertification will be needed for the different conditions. Action plans should give priority to the application of existing knowledge to local situations

Solution: Empowering women

Millennium Development Goal 3 is to promote gender equality and empower women. Ireland is committed to contributing to reaching the goal. For Irish Aid, the goal of promoting gender equality is now recognised as a core priority for all development interventions.

Women in subsistence economies are the major suppliers of food, fuel, and water for their families, and yet their access to land is declining. Investing in women is the best way to increase food security, reduce population growth and relieve pressure on the environment.

Empowering women is vital for sustainable natural resource development. Efforts are needed to train more women in forestry and natural resource activities in order to enhance their participation at all levels - from grassroots to international policy.

Solution: Development of local crops and rural markets

The convention proposes the promotion of drought-resistant and salt-resistant crops and the development of rural markets. Attention should be paid to local plants whether they have already been domesticated or not. It is important to grow a wide variety of plants that are suited to local conditions. Bio-diversity of crops helps to ensure both healthy soil and food-security. Organic growing should also be encouraged as this system reduces the damage to the land and alleviates some of the negative impacts of monocropping.

Local markets are needed to encourage local trade and the production of local goods, both agricultural and non-agricultural. An emphasis on the export of unprocessed commodities has a detrimental effect on local economics. If this situation could be changed more income could be earned without so much damage to the soil.

As part of Concern's Livelihoods Programmes in both the Democratic Republic of Congo and Sierra Leone access to markets has been improved through the provision and rehabilitation of bridges and feeder roads.

National Action Programmes should give particular attention to protecting lands not yet degraded, and devise early drought-warning systems.



Paulo Vitorino plants potatoes with seed supplied by Concern, Angola.
Photo: Pieterella Pieterse/Concern

? QUESTION SHEET SECTION TWO

- 1) List three benefits of trees in combating desertification.

- 2) Explain in three sentences how trees help to retain moisture in an area.

- 3) What is agroforestry?

- 4) Describe in one or two sentences
Alleycropping

Riparian forest buffers

- 5) Explain the structure of contour bunding and its benefits.

- 6) List two reasons why the empowerment and training of women is important in the fight against desertification.

- 7) Why are different solutions to combat desertification needed in different areas?

- 8) What two characteristics are important in food plants in drylands areas?

Open Questions

- 9) Were you already aware that desertification was a major global problem? _____

- 10) Have you read or heard about desertification in the media? _____

- 11) If Yes did the images or language help you to understand the issue more fully?
Explain answer in two or three sentences.





Section Three

PURPOSE

After completing this section students will have explored;

- how desertification links with the United Nations Framework Convention on Climate Change and with the Convention on Biological Diversity
- soil saving initiatives carried out around the world
- vegetation of the dune ecosystem – an Irish study
- what can we do about desertification?

Biodiversity and cultural richness in Drylands

Biological diversity includes countless plants that feed and heal people, crop varieties and aquatic species with specific nutritional characteristics, livestock species adapted to harsh environments, insects and birds that pollinate fields and micro-organisms that regenerate agricultural soils.

Wangari Muta Maathai, Kenya's Green Militant, stressed that if we want to save the environment we should protect the people first, because human beings are part of biological diversity.

In Africa, environmentalists have focused on the conservation of endangered animals and plants while taking little account of the needs of poor people. Conservation efforts on protected area systems have often been resisted by local people whose livelihoods have been threatened.

People from nomadic and pastoral cultures who live in drylands use wild species and plants for food, decoration and medicine. Dryland populations have developed traditional systems of land care in order to benefit from biodiversity without destroying resources.

Protect Biodiversity in Drylands

The theme for the observance of International Day for Biological Diversity 2006 was Protect Biodiversity in Drylands. The choice of this theme highlights the links between these two environmental issues.

Desertification as an issue does not stand in isolation but is related to changes in climate, biodiversity conservation and the need for sustainable forest and water resource management. www.desertification.net/

- Deforestation is a cause of desertification and of loss of bio-diversity and a significant contributory factor in global warming.
- Desertification and land degradation affects global climate change through soil and vegetation losses.
- Desertification threatens the rich diversity of plant and animal life found in dryland ecosystems.

- Trees and vegetation - which are included in biodiversity - are essential for the removal of carbon dioxide from the atmosphere and therefore help to regulate climate change.

Environmental approaches for combating desertification, conserving biodiversity and mitigating climate change are linked in many ways. Reforestation to reclaim degraded land helps to preserve bio-diversity and to mitigate climate change through absorbing carbon dioxide. To achieve holistic earth-care, countries should promote interrelated action plans for implementing the three closely linked conventions which grew out of the 1992 Earth Summit:

- the Convention to Combat Desertification (CDD)
- the Convention on Biological Diversity (CBD)
- the United Nations Framework Convention on Climate Change (UNFCCC)

Haiti is a typical case of a fragile ecosystem, subject to both desertification and drought. The island of Haiti possesses one of the highest biodiversity indices in the tropics and is known to have a great variety of species and ecosystems.

Soil saving around the world

The Eden Foundation is a Scandinavian NGO working on re-vegetation projects in the Sahel area. Eden's solution to desertification is for farmers to stabilise their environment by intercropping edible perennials in their fields. Polyculture, the planting of a variety of crops, enables better distribution of land resources and limits soil exhaustion.

www.eden-foundation.org/project/desertif.html

Tamil Nadu, South India

Two million forest, nut and fruit trees, hedges, and shrubs were planted in Auroville, in Tamil Nadu, South India. Auroville, an international community, was established in 1968 on a severely eroded plateau. In 1968 the plateau reflected in microcosm the larger global problem. Over-exploitation and lack of restorative care threatened the land's ability to grow plants. Severely deforested, overgrazed and overcultivated, the land was subject to erosion. Both wind and rain contributed to heavy topsoil erosion. The monsoons would wash over the barren land, carrying topsoil to the ocean and creating deep ravines and gullies.



Mali

Mali is a landlocked country, at the southern edge of the Sahara desert. For generations, farmers in Mali protected their gardens with hedges of *Jatropha curcas*, or physic nut, which is not eaten by animals and therefore protects the foodcrops as a living fence. As well as controlling animal access, the "living fences" reduce wind erosion and, if planted parallel to slopes, also help to control water erosion. The fences slow surface runoff during downpours resulting in more water penetrating into the soil and boosting harvests. The plant's roots anchor the soil.

By using locally produced *Jatropha* oil as fuel and lubrication oil, some of the cash outflow from the village can be stopped. Traditionally, rural women used *Jatropha curcas* for medicine and soap production. The soap is sold in local markets and nearby towns, increasing their possibilities of earning income with local resources. The residual "presscake" after the oil has been extracted is used to fertilise the soil.

www.ag.arizona.edu/OALS/ALN/aln40/jatropha.html & www.jatropha.de/

Uganda

Uganda is a very poor country where life expectancy is just 47.3 years compared to Ireland's life expectancy rate of 77.7 years. Uganda largely depends on rainfed agriculture and, is therefore, vulnerable to droughts and their effects. In Uganda District Steering Committees for Combating Desertification were established. These Steering Committees coordinate the activities of the NAP process and provide technical support to local community initiatives being undertaken in collaboration with NGOs and CBOs.

www.unccd.int/

Tanzania

The Manyara ranch managed by the Tanzania Land Conservation Trust is working on reconciling pastoralism with wildlife conservation by using the ranch as a wildlife corridor for seasonal migrations, thus promoting sustainable land use through livestock rearing, wildlife conservation and other land uses.

The Dunes are an ecosystem in Ireland which have some similarities to drylands

Ireland, has not escaped land degradation. So far it has escaped desertification because of its temperate climate. One Irish ecosystem worth studying in relation to drylands is the dunes.

The plants found on dunes have characteristics similar to those needed in dryland habitats. They need:

- to be able to germinate at the smallest opportunity in a very poor environment
- to survive in a salt laden environment
- to survive the drying effect of wind
- to bind sand in the earliest stage of dune development
- to stabilise the dunes as they reach several metres
- to fertilise and add humus to the mature dunes

Marram grass reproduces itself like an ear of corn. Every time it is covered over by sand it sprouts new roots further up. This multi-storey root system is an excellent aid to dune building.

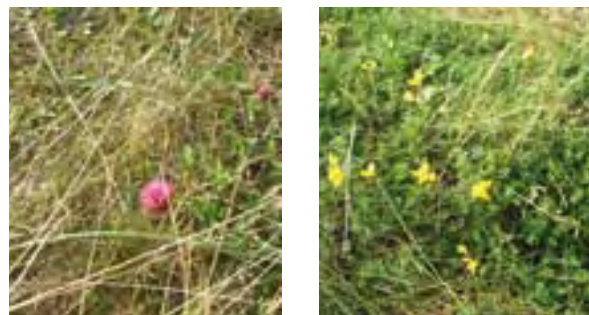


Left to right: Marram Grass at Dollymount Dunes, Sea Buckthorn at Dollymount Dunes, Photos: Fran Brady.

Sea Buckthorn has often been introduced onto dunes to help stabilise them. It has nitrogen fixing root nodules and so can thrive even on nutrient-poor young dunes. Sea buckthorn is very invasive and can exclude most other vegetation.

Other leguminous plants common in the semi-fixed dunes include red clover (*Trifolium pratense* L.), white clover, Birds Foot Trefoil *Lotus corniculatus* and Restharrow *Ononis repens*.

Red clover and White clover are short-lived perennial legumes which are very common in Ireland. They lack sufficient drought tolerance to survive prolonged dry spells.



Left to right: Red Clover at Dollymount Dunes, Birdsfoot Trefoil Dollymount Dunes, Photos: Fran Brady.

What can we do?

Although Ireland is not subject to desertification, because of its temperate climate, desertification is a global issue which is relevant to all of us.

We can all

- Make everyday choices for a more sustainable lifestyle
- Mobilise for environmental and social justice

Sustainable Living

Sustainable living means that people living on the planet should leave the environment in as good, or better condition than we found it for future generations.

Reduce our Energy Use

Ireland's rate of CO₂ emissions is 10 tonnes for every person in the country. That is ten times the global average of one tonne for every person.

Simple activities can make a big difference.

- walking or cycling short distances
- switching off lights
- only boiling as much water as you need
- lowering the central heating thermostat by just 1°C – reduces energy use by 10%
- waiting until the washing machine is full to turn it on
- buying local food

The global food system is dependent on petroleum, which has limited sources and its uncontrolled use is also leading to global warming.

The average meal in America travels 2400 kilometres from field to fork. How far does our food travel? We can check the labels. Fossil fuel is needed to transport our food.

There are many more activities which you or your friends or family may already be doing. We can all share our tips for sustainability and we can also visit www.powerofone.ie/

Sustain Soil

- Keep soil covered with vegetation.
- Grow some food. This will relieve the pressure on distant lands and also save energy needed to transport food over thousands of kilometres.
- Landscape areas with a mix of wildflowers, herbs, and other forms of vegetation natural to the area.
- Set up a compost bin. The compost can be used when growing food and flowers.
- Disturb as little soil as possible, and save and replace topsoil removed during any construction work.

Sustainable Forests

Irish society has a role to play in putting a halt to destructive deforestation. We can all reduce our demand for paper through simple steps such as writing, or printing, on both sides of the paper or reusing gift wrapping paper and envelopes. It takes 17 trees to make a tonne of paper.

Architects, local authorities, construction companies, woodwork teachers, joineries and D.I.Y enthusiasts can insist on wood-based products from independently certified forests.

The Forest Stewardship Council is an international non-profit organisation founded in 1993 to support environmentally appropriate, socially beneficial and economically viable use of the world's forests. All products carrying the FSC logo have been independently certified as coming from forests that meet internationally recognised FSC Principles and Criteria. For more information please contact **Just Forests: www.justforests.org or 046-9737545**

Reduce Water Waste

The amount of water used by one person in Ireland per day is 150-250 litres, only 2 litres of which are used for drinking. The amount of water used by one person in Kenya per day is 4 litres. In Africa, women spend a large part of everyday carrying water over great distances. Visit www.taptips.ie for practical ways to reduce water use everyday at home, at school at work or in the garden.

Help Preserve Biodiversity

- Plant trees and take care of them.
- Reduce use of wood and paper products, recycle paper, and buy recycled paper products.
- Only buy wood products that have been certified as having been grown in a sustainable manner.
- Help rehabilitate or restore a degraded area of forest or grassland near your home.

Mobilise for environmental and social justice

The Comhlamh Trade Justice Group campaigns aim to mobilise public pressure on our Irish and European trade and development representatives to "make trade fair" for poorer countries. Visit www.comhlamh.org/campaigns/16 to find out about ways you can help.



? QUESTION SHEET SECTION THREE

- 1) What is described as Mali's living hedge?

- 2) Describe how the living hedges are both environmentally and economically beneficial to the local people.

- 3) If you want to save the environment you should protect the people first. List 2 reasons for this statement.

- 4) What is meant by leguminous plants?

- 5) Name two leguminous plants that help in the development of mature dunes.

- 6) Name any leguminous plants used in agricultural situations.

- 7) Why would red and white clover not be so suitable in dryland areas?

- 8) Identify two trends that happen during wet years and that can contribute to the process of desertification.

- 9) Explain how desertification threatens the well-being of people.

- 10) How does desertification hinder the attainment millennium goals?

- 11) In Africa, there is growing recognition that indigenous knowledge makes a valuable contribution to land and agricultural systems. In one sentence explain indigenous knowledge.

- 12) Is there a place for this type of knowledge in the contemporary fight against desertification?

- 13) What is community or social forestry?

WEB LINKS - FURTHER INFORMATION



Here are some links to help you find out more about Combating Desertification

1) UNCCD

This site has very useful information on the Convention to Combat Desertification and on the International Year of Deserts and Desertification.

→ www.unccd.int/

2) World Environment Day – Inspiring ideas

The World Environment Day theme selected for 5th June 2006 was Deserts and Desertification and the slogan was Don't Desert Drylands! The slogan emphasizes the importance of protecting drylands, which cover more than 40% of the planet's land area. This web site includes Inspiring Ideas from around the World.

→ www.unep.org/wed/2006/english/

3) The Eden Foundation

The Eden Foundation founded in 1985 in Sweden is active in Tanout, Niger, since 1987. This site gives a very informative description of desertification in Sahel. It includes diagrams, pictures and reports on fallen crop yields.

→ www.eden-foundation.org/project//desertif.html

4) World Agroforestry

This site is very useful for describing the benefits of Agroforestry and it also has a description of agroforestry in Sahel.

→ www.worldagroforestry.org/Agroforestry.asp

5) WWF

WWF conserves endangered species, protects threatened habitats and addresses global threats. We find long-term solutions that benefit both people and nature. This web page within the site illustrates how intensive olive growing is leading to desertification in Europe.

→ www.wwf.org.uk/news/n_0000000290.asp

6) UNEP

Land degradation is a serious problem throughout Africa, threatening economic and physical survival. This site looks at the key issues including escalating soil erosion, declining fertility, salinization, soil compaction, agrochemical pollution and desertification. It also shows the decline in per capita food production in Africa.

→ www.unep.org/GEO2000/english/0053.htm

7) Our Planet

Desertification is both a cause and a consequence of poverty. This site looks at the poverty, food insecurity and the social and economic hardship caused by desertification.

→ www.ourplanet.com/imgversn/133/diallo.html

8) Jatropha

This site shows how the Jatropha System creates a positive reciprocity between raw material / energy production and environment / food production and gives further insight into the living hedges described in Mali.

→ www.jatropha.de/

9) Dustbowl Disaster

This site gives a good description of the Dustbowl disaster in US in the 1930s.

→ www.drought.unl.edu/whatis/dustbowl.htm#intro



Answers...

QUESTION SHEET SECTION ONE

- 1) Desertification is the degradation of lands in dry areas which results in the lowering of the biological and food producing potential of these lands.
- 2) The world's drylands are mainly found in two belts centred on the Tropics of Cancer and the Tropics of Capricorn. Other dryland areas include the North American Great Plains and parts of Central Asia which are in the rain shadow of mountains.
- 3) Worldwide more than 110 countries have drylands potentially at risk of desertification.
- 4) Desertification is caused mainly by unsustainable land-use practices, such as overcultivation, overgrazing, deforestation, and poor irrigation.
- 5) The principal causes of deforestation in Eritrea are tree cutting for fuelwood, tree felling for construction poles for the traditional highlands home (Hidmos) and forest and bush fires.
- 6) Desertification is found mostly in areas where there is low and erratic rainfall. Low rainfall leads to drought and drought, through causing a decrease in vegetation yield forces people to overexploit their land to survive.
- 7) The cultivation of rainfed crops needs more than 350-400mm of rainfall.
- 8) Salinisation is a form of desertification which occurs in irrigated cropping systems when evaporation removes the water from waterlogged soils and leaves increasing salt levels in the soil.
- 9) Fallowing is a practice of allowing a field to rest between cropping. A natural ground cover can protect, fertilize and improve the structure of the soil and can be grazed on by livestock and then ploughed back into soil.
- 10) They were sensitive to the capacity of the land and grew crops only where the rainfall was adequate and reserved the driest lands for nomadic herding. A variety of crops were grown in case of crop failure.
- 11) Intensive olive cultivation is degrading the soil across the Mediterranean region. Up to 80 million tonnes of topsoil is lost every year from olive plantations in the Spanish region of Andalusia alone.
- 12) The need for foreign exchange.
- 13) The need for survival compels poor people to farm in a way that can do long-term damage to the environment. When the land becomes too degraded to produce food, they are often forced into internal and cross-border migrations.
- 14) Soil erosion causes the soils to become shallow and of low fertility and the water-holding capacity of the soil decreases. Rivers flood excessively during occasional intense rainfalls. The surface water is rapidly lost through evaporation and rivers and lakes disappear. Degraded land may cause downstream flooding, sedimentation in rivers and lakes, and siltation of reservoirs and navigation channels.

QUESTION SHEET SECTION TWO

- 1) Trees stabilise and protect the soil, shade it from excessive sunshine and strong winds, retain moisture and replenish soil nutrients with fallen leaves.
- 2) The tree canopy intercepts the rainfall; and the water that trickles down through the canopy is absorbed by the humus, permitting local recycling of the rainfall. By shading the soil from excessive sunshine trees prevent excessive evaporation.
- 3) Agroforestry is a practice which integrates high-value multi-purpose trees and shrubs into farming systems.
- 4) Alleycropping is the inter-cropping of trees and crops simultaneously. The deep roots of the chosen trees minimize below-ground competition with crops, enabling these systems to be agro-ecologically sound and economically viable.
Riparian forest buffers are areas of forested land adjacent to streams, rivers, marshes or shoreline. Riparian buffers are a river's best protection against erosion, pollution and sedimentation.
- 5) Interlocking grids of earth mounds enclose areas of land, preventing runoff and allowing rainwater to percolate down to replenish the water table and preserving what is left of the topsoil.
- 6) Women in developing countries do much of the work on the land and are often most affected by desertification. Empowering women is vital for sustainable natural resource development.
- 7) Drylands comprise a wide variety of biophysical, economic and social settings.
- 8) Drought-resistance and salt-resistance.

QUESTION SHEET SECTION THREE

- 1) Farmers in Mali have protected their gardens with hedges of *Jatropha curcas*, or physic nut, which is not eaten by animals and therefore protects the foodcrops as a living fence.
- 2) The fences reduce wind erosion and help to control water erosion. They act as buffers to slow surface runoff resulting in more water penetrating into the soil and boosting harvests. The community has locally produced *Jatropha* oil, medicine which brings in income and saves outflow of cash. The residual "presscake" after the oil has been extracted is used to fertilise the soil.
- 3) In Africa, environmentalists have often focused on the conservation of endangered animals, plants and trees taking little account of the needs of the poor people. Conservation efforts on protected area systems have often been resisted by local people whose livelihoods have been jeopardised. People can be allies of the conservationists, but for this to come about we have to focus much more on sustainable use, rather than on conservation for its own sake.
- 4) Nitrogen-fixing bacteria form symbiotic associations with the roots of legumes. The plant supplies simple carbon compounds to the bacteria, and the bacteria convert nitrogen (N₂) from air into a form the plant host can use. When leaves or roots from the host plant decompose, soil nitrogen increases in the surrounding area.
- 5) Bird's foot trefoil (*Lotus corniculatus*) and Restharrow, Kidney Vetch and members of the clover family.
- 6) Red clover (*Trifolium pratense* L) and White Clover are popular in agricultural situations.
- 7) They are not drought-tolerant.
- 8) In dryland pastoral economies, large numbers of stock build up during runs of good years, too many to be supported through a drought. Dryland farmers have a tendency after a period of good years to extend their cropping onto more marginal lands and this decreases the range for pastoralists.
- 9) The most obvious impact of desertification is a decline in food. Crops and natural vegetation grow poorly, forcing people to crop and graze the land more to compensate for lower yields. This destroys vegetation even further and this can lead to hunger and poverty.
- 10) The eight Millennium Development Goals range from halving extreme poverty to providing universal primary education, by the target date of 2015. Desertification hinders the attainment of at least two of these goals: goal one - eradicate extreme poverty and hunger and goal seven - ensure environmental sustainability.
- 11) Over the years local populations in Africa developed techniques for managing soil and water, domesticating plants and animals, and for forecasting the weather.
- 12) The Convention states that traditional and local technologies and know-how should be protected. Local populations should benefit directly from any commercial use of their techniques.
- 13) The objective of community forestry is to meet the needs of the people in a way that is sustainable by making forest products available to them. Community forests can ensure that local people gain more secure rights to use and manage the forest for their own benefit. This can provide a strong incentive for them to protect the forest in the long term.



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