S

93401R

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2007
Geography

2.00 pm Saturday 1 December 2007

RESOURCE BOOKLET

On the Edge – Desertification

For copyright reasons, some of the resources in this booklet cannot be reproduced here.

Refer to this booklet to answer the questions for Scholarship Geography 93401.

Check that this booklet has pages 2–19 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

On the Edge – Desertification

Desertification, global warming, deforestation, and sustainable living are examples of issues that are the subject of much contemporary academic research and considerable political and public debate. These issues are all geographical. They involve links between people and the environment, have a spatial dimension, and can be studied on a variety of scales.

This examination focuses on one of these issues: desertification.

Desertification: Definitions

- Desertification can mean either the spread of existing deserts into areas nearby, or the process by which large areas of once fertile and productive land are degraded (ruined) to the point where they are no longer of any use for farming. (AusAID / Canberra Times 2006)
- Land degradation is the process whereby the soil becomes less productive as a result of physical factors such as drought, or human factors connected with bad management of the land … Desertification results from large scale and long-term land degradation, specifically in drier parts of the world. (Michael Hill, '*Arid and Semi-Arid Environments*', 2002)

PART ONE: DESERTIFICATION BACKGROUND AND A GLOBAL VIEW

The United Nations Convention to Combat Desertification (UNCCD) estimates that globally since 1990 about six million hectares of productive land have become degraded every year. Former UN Secretary-General Kofi Annan said that governments must focus on reversing this trend, and cooperate with civil society, business, and international organizations to promote more sustainable development so that land remains arable and does not become desert. The Secretary-General said desertification "Contributes to food insecurity, famine and poverty, and can give rise to social, economic and political tensions that can cause conflicts, more poverty and further land degradation".

The UNCCD Secretariat estimates that more than one billion people in 110 countries and one-third of the Earth's surface are threatened by desertification by the end of the 21st century.

The impact of desertification varies greatly, with less-developed countries experiencing greater human misery than those with the resources to provide short and long term relief to affected populations.

UNESCO (United Nations Educational, Scientific, and Cultural Organisation) FOUR CATEGORIES OF DESERTIFICATION	
SLIGHT	little or no degradation of the soil; little loss of plant cover
MODERATE	26–50% of the plant community consists of climax species
	25–72% of the original topsoil lost
	soil salinity has reduced crop yields by 10–50%
SEVERE	10–25% of the plant community consists of climax species
	erosion has removed all or most of the topsoil
	soil salinity has reduced crop yields by more than 50%
VERY SEVERE	less than 10% of the plant community consists of climax species
	erosion has left the land with many sand dunes or deep gullies
	salt crusts have developed over irrigated soils which are barely permeable

United Nations Poster: International Year of Deserts and Desertification (2006)

A view of the future

Source: SchNews (a UK environment and social issues campaign and action group), 10 November 2006

Global Spatial Patterns:
World vulnerability to desertification – where the greatest threat lies

United States Department of Agriculture-Natural Resources Conservation Service, 1998: Global Desertification VulnerabilityMap, Soil Survey Division, Washington, D.C. (available at: http://soils.usda.gov/use/worldsoils/mapindex/desert.html).

Looking back and looking forward

Desertification is not a new phenomenon. Geological, geomorphological, archaeological, and historical evidence plus recent satellite imagery all indicate that many present-day desert regions were wetter in the past than they are today. These sources provide evidence of long, medium and short term changes to climate and land.

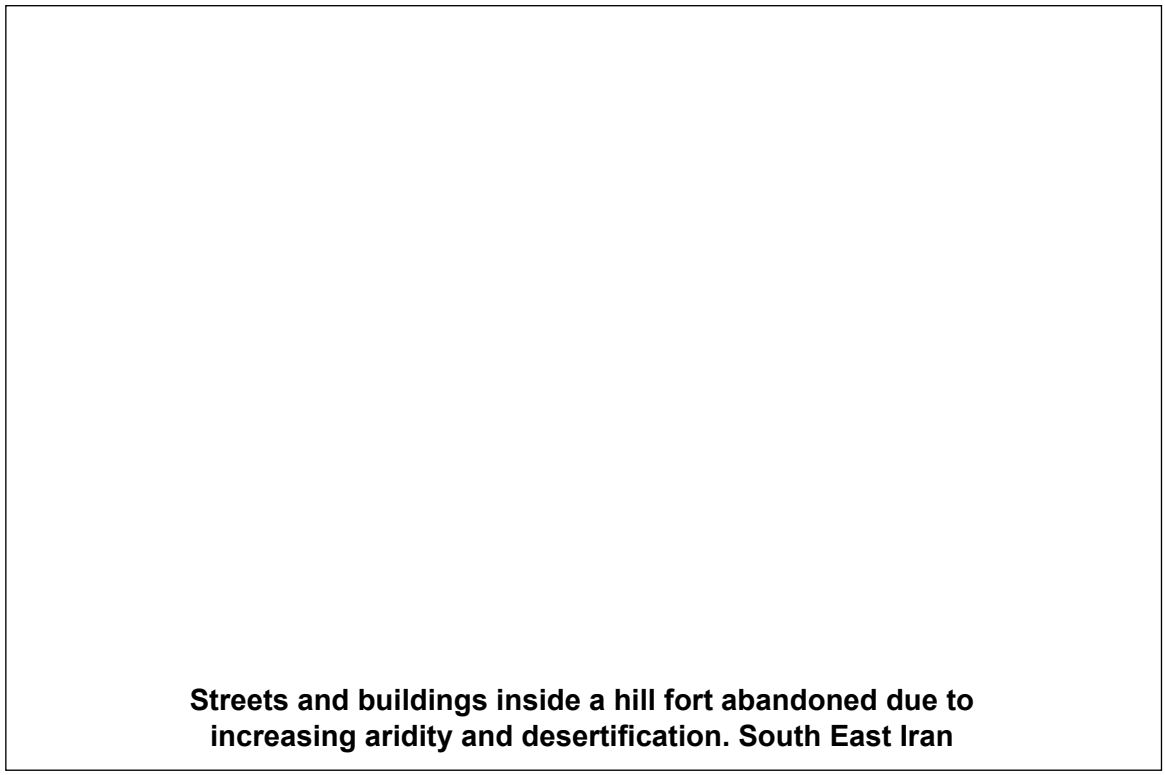
Three quarters of Africa's agricultural drylands are already degraded to some degree. The impact of desertification on the greatest number of people occurs in Asia. Degraded areas range from the sand dunes of Syria to the eroded mountain slopes of Nepal and the deforested and overgrazed highlands of Laos. The Northern Mediterranean region has also suffered badly. Here salinized, infertile soils are the result of natural hazards, eg droughts, floods and forest fire, as well as overtilling and overgrazing. In Latin America and the Caribbean nearly a quarter of the inhabitants live below the poverty line and this fuels land use practices that lead to land degradation.

Soil Degradation by Region in Susceptible Drylands
(UN Environment Programme July 2002)

	Water erosion	Wind erosion	Chemical deterioration	Physical deterioration of the soil structure	Total
	Million Hectares				
North America	38.4	37.8	2.2	1.0	79.4
South America	34.7	26.9	17.0	0.4	79.0
Europe	48.1	38.6	4.1	8.6	99.4
Africa	119.1	159.9	26.5	13.9	319.4
Asia	157.5	153.2	50.2	9.6	370.5
Australasia	69.6	16.0	0.6	1.2	87.4
Total	**467.4**	**432.4**	**100.7**	**34.7**	**1 035.2**

The 2007 Intergovernmental Panel on Climate Change (IPCC) report suggests that increased drought and desertification in some parts of the world will be one consequence of global warming during the 21st century. British scientists warn of drought threatening the lives of millions because of global warming.

Andrew Simms from the New Economics Foundation, an expert on the effects of climate change on developing countries said: "*There is almost no aspect of life these predictions do not undermine – the ability to grow food, the ability to have a safe sanitation system, the availability of water.*"



Streets and buildings inside a hill fort abandoned due to increasing aridity and desertification. South East Iran

The spreading Gobi Desert in Central Asia

The Causes of Desertification

- Desertification is caused by complex interactions between the natural environment and human activities. The causes may vary from region to region due to economic conditions, population pressure, agricultural practices, and politics. Human activities that destroy surface vegetation, degrade soil structure and fertility, impede water infiltration, and cause soil drying, all promote desertification. This is especially true for the fragile transition zone between arid and semi-arid land where human activity has overstressed the ecosystem.
- Population growth puts pressure on agricultural resources and this has accelerated the desertification process. Increased demand for food crops leads to over-cultivation which in turn causes declining soil fertility resulting in falling crop yields. Overuse of land leads to crusting of exposed topsoil by rain and sun, and this, in turn, increases runoff, water erosion and gullying. Soil drying accelerates wind erosion and the encroachment of sand dunes onto arable land.
- Overgrazing is the major cause of desertification worldwide. By pounding the soil with their hooves, livestock compact the ground, increase the proportion of fine material, and reduce the percolation rates, thus encouraging erosion by wind and water. Grazing combined with the collection of firewood reduces or eliminates plants that help to bind the soil.
- Growth in population and livestock numbers in marginal lands has accelerated desertification. Where nomads move to less arid areas they disrupt local ecosystems and increase land erosion rates. Nomads are trying to escape the desert, but because of their land-use practices, they bring the desert with them.
- Degradation of formerly productive land – desertification – has multiple causes, and proceeds at varying rates in different climates. Desertification may intensify a general climatic trend toward greater aridity, or it may initiate a change in local climate. When human land use practices causing desertification coincide with drought, rates of desertification increase and in the worst situations can become self-reinforcing with conditions set for continual deterioration.

PART TWO: COMBATING DESERTIFICATION

There is little doubt that desertification is a global problem but its complex nature means there is no general solution.

(G. Pickup, *Desertification and Climate Change – the Australian Perspective.*)

(A) The Green Wall of China

BEIJING TURNS BACK THE TIDE OF SAND

China has announced it has slowed the rate at which desertification is eating up farm and other land. Officials expressed confidence that the 2008 Olympic Games in Beijing would not be affected by the sandstorms that sweep the country every year.

Desertification in western China and the Mongolian steppes has led to the spring sandstorms reaching as far away as South Korea and Japan. Persistent drought in northern China has made the problem worse, sucking moisture from the soil and making it more easily picked up by the wind. Adding to the problem is the introduction of European cattle such as the Friesian, which eat more vegetation than Asian breeds.

Zhu Lieke, deputy head of the State Forestry Administration said the rate of desertification has been slowed with the introduction of improved agricultural practices, and the aim was to rescue half of all the land destroyed by desertification by 2020.

Beijing has embarked on a huge tree planting programme to create an enormous "green wall" – nearly as long as the Great Wall of China – to halt the spread of the sandy lands. Oases and farmlands in dry, windy regions are also being protected by planting tree fences and grass belts: sand that passes through the grass belts will be caught in the treed areas before it reaches the farmed land.

(Adapted from *The New Zealand Herald*, 31 May 2006.)

Desert dust chokes Beijing

The Green Wall of China: a view from the outside

- In parts of north-west China, farmland, villages, railways, roads, and rivers are all being engulfed by spreading deserts. China's deserts are on the move. The government's response? Declare the creation of a "Green Wall" – a tree planting effort across a 4480 km stretch in north-western China. Unfortunately, it's not working. Millions of trees have been planted, but few survive. Hundreds of thousands of herders have been forcibly relocated, but the grasslands continue to parch and blow away. Huge armies of local labour have been drafted to try to stabilise dunes and build sand fences, but the dunes keep coming.
- The Green Wall is a top-down mega-project fix, while by most expert accounts, China needs a grassroots-driven mega-collaboration response to halt desertification. Local people need the power, information and tools to combat the spreading deserts. Centrally planning an effort of unparalleled scope, involving an incredible diversity of places, peoples and situations is crazy. Having some official in Beijing point at a map and say "plant trees here", will never match the results of directly involving villagers whose fields and homes are threatened by the swirling sands.
- China has real advantages in meeting environmental challenges, if it chose to use them – a history of doing imaginative work, a brilliant and well-trained scientific community, a culture of cooperative efforts. It has already begun a project to monitor desertification, involving almost 10 000 researchers "combining land-surface survey with satellite remote-sensing technology, GIS and the global positioning system".
- While many in the funding world still see grass-roots and high-tech, local and networked, traditional and smart, as contradictory terms, people in India, Sub-Saharan Africa, and Central America have been proving they are not. Examples abound of the power of technology, better information and freer communication to help most those with the least. There are countless examples of how local people, armed with the right information and incentives, often do a better job of protecting their land than outside agencies.

(Adapted from Alex Steffen, "*World Changing*", 29 December 2003.)

Part of the Great Green Wall

(B) Turning back the sands

Environmental rehabilitation in Inner Mongolia, China: Alxa League

Grazing too many goats loosens the ground cover, leading to desertification of the fragile environment.

Alxa League is a provincial area in the west of China's Inner Mongolia Autonomous Region. It is an area of 270,000 square kilometers with a population of just 200,000. Two large deserts dominate the area: the Tenggeli Desert and the Gobi Desert. These deserts have huge temperature ranges, from highs of 40°C in summer to very cold winter temperatures of below minus 30°C.

Drought, and poor land use practices have caused serious problems for the grasslands and for the local herdsmen who make a living from their flocks of sheep, goats and camels. Overgrazing has destroyed the vegetation cover and this has allowed strong winds to blow the sandy topsoil away causing the silting up of rivers and lakes and bringing dust storms to places as far away as Beijing, Japan and Korea.

The Chinese and Australian governments have been working with local herdspeople to try to fix this land degradation problem. The Alxa League project aims to help local people understand the problem and how to mitigate it. It helps them to develop sustainable land-use and lifestyle practices by:

- Managing their land better by fencing off areas for stock and allowing vegetation cover to grow back.
- Breeding high quality animals, so they can keep fewer animals but still make the same amount of money.

Dried-up lake bed in the Alxa region

- Planting trees across the edge of the desert to hold back the sand and to give some protection from the hot winds.
- Conserving water by using drip irrigation and concreting irrigation channels to reduce water seepage loss.
- Installing methane digesters under pig pens to turn animal waste into biogas. This reduces, by up to 80%, the need to cut down trees for cooking fuel.
- Exploring ways of making a living through tourism and the growing of desert ginseng – a valuable plant for herbal medicine.
- Developing an environmental education programme in schools and having students monitor revegetation sites and recognize the value of the new land-use practices.

(Source: AusAID and *The Canberra Times*, 2006.)

New crossbred sheep kept in winter pens for warmth and to reduce vegetation damage

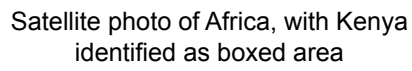
(C) Regaining the High Ground

Reviving the Hillsides of Machakos, Kenya

The Machakos region, in the highlands to the east of the capital city Nairobi, is the home of the Akamba people. It is an area where desertification has been tackled with much success.

Life has not always been good in Machakos. In the 1930s, soil erosion plagued 75% of the inhabited area and the people living in the area were described as "rapidly drifting into a state of hopeless and miserable poverty and their land to a parching desert of rocks, stones and sand". In the Machakos district the natural ecosystem is savanna where the land is covered in tall grass, bushes and scattered trees. Savanna vegetation is adapted to survive months of drought. However as the region became drier this vegetation became stressed. At the same time population numbers increased. This had a twofold effect on farming: livestock were squeezed onto smaller and smaller areas of flatter land to allow for an expansion in the cultivated area, and steep hillsides were cleared for cultivation. The overgrazing of flatter land by livestock, and the exposure of cleared steep hillside soil, accelerated the process of desertification already being driven by the drier climate. The farmers knew that farming in this way was unsustainable and was leading to environmental catastrophe. Machakos was becoming a desert.

Today, once-eroding hillsides are productive, intensively farmed terraces. The cultivated area has increased and supports a population of around 1.5 million: five times more than lived here in the 1930s. This environmental transformation has been called 'the Machakos Miracle'.



Satellite photo of Africa, with Kenya identified as boxed area

Accelerated gully erosion on exposed flat savannah

Productive hillside today in Machakos

The Machakos Miracle

Instead of seeing themselves as part of the problem, the people in Machakos saw themselves as part of the solution. They set up self-help groups to work on conservation projects to improve the land and they developed an environmentally sustainable farming system. Central government allowed a lot of local decision making: this recognised the intimate knowledge the Akamba had of the land's problems and their culturally preferred agricultural methods. It also capitalised on their abiding attachment to the land. "It is not just economic," said Maria Mullei who farms in the area and gives agricultural advice, "you love the land so you protect it".
In much of Machakos today, farms flourish in place of deserts.

Machakos Overview

Machakos Today

Big challenges lie ahead still in Machakos. Economic stagnation and poverty, continued population growth and scarcity of new farmland are putting pressure on the sustainability of the land-use practices. Any future long term climate change that increases aridity will add to this pressure and could undo the advances of the past 50 years.

PART THREE: AUSTRALIA – (UN)LUCKY COUNTRY?

Jim Salinger, a lead author for the Intergovernmental Panel on Climate Change (IPCC) Australasian chapter, painted a grim outlook for Australia. "Australia is very much the drying continent," Dr Salinger told journalists. "Large areas are likely to have less rainfall and soil moisture in the future. The Murray-Darling river system will face huge drops in water levels. This has dramatic implications for crop, pastoral and grazier land production over much of southern and eastern Australia".

(*Sydney Morning Herald*, April 2007.)

Drowned town surfaces after 50 years

The little town of Adaminaby was drowned in 1958 beneath a huge artificial lake: part of the Snowy Mountains hydro scheme. Buildings were moved to higher ground and what was left disappeared into a watery grave.

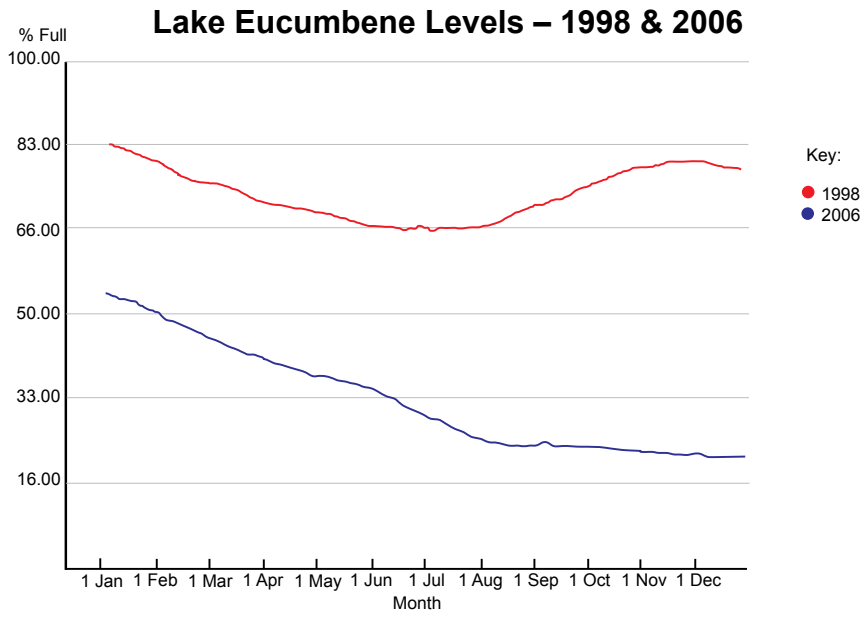
Now the ruins of the old township have reemerged due to the long drought. Lake Eucumbene has dropped by 36 m, revealing remnants of the past life of Adaminaby.

The receding waters have exposed rusting machinery, old bottles, and the Catholic church's staircase and two gateposts have reappeared.

Greg Russell, 82, grew up nearby. Wandering among the ruins has been an eerie experience. "It makes me feel nostalgic for a place that doesn't exist any more," said Russell.

(Adapted from *The New Zealand Herald*, 5 February 2007.)

The Snowy hydro scheme created many lakes – the drought is causing them to dry up. Lake Eucumbene in March 2007.



Lifeblood at a Trickle – The Big Dry

The Murray-Darling river system has been reduced to a trickle and is stricken by salination. Across the river basin fields are parched, livestock are dying and farmers face ruin. The basin accounts for 34% of Australia's agricultural production. Australia's food supplies rely on output from the basin.

Eastern Australia is in its sixth year of drought – the worst in 100 years. River inflows in 2006 were at an all time low and evaporation high. Farmers pumping groundwater at record rates for irrigation further reduced river inflows. By 2030 the river is predicted to dry up a further 20% due to global warming-induced drought.

Cate Faehrmann from the Nature Conservation Council of New South Wales said "I can imagine some of these agricultural areas being a desert in a few decades. Soil is blowing away, rivers are drying up. Whole agricultural practices will be abandoned."

South East Australia and the Murray-Darling basin

Australia – Rainfall Variation

I Love A Sunburnt Country – Not!

I hate this sunburnt
country,
of dying stock
and lost hope,
of shriveled crops
and callous banks,
of ignorant cities
and silent tears,
of empty shops
and shattered dreams,
of heat and dry
sucking life out
of the cracked earth,
killing this wide
brown land.

Source: *Heinemann Geography 1*, 2006, p 192.

Land use, drought, and desertification in Australia: past, present and future

"*We are all wondering if the future is arriving faster than we thought it would.*"

– Roger Jones, Australian climate scientist

Ecologically, the Australian environment is fragile. Rainfall is highly variable but the soils have caused an even greater problem. The soils have been leached of their minerals over many years and in places are highly saline. Land degradation is due to unsuitable land use or poor land management in the arid and semi-arid rangelands where the principal land use is commercial pastoralism. European farmers introduced sheep and cattle to the rangelands around natural water areas, artesian bores and dams. Huge stock losses soon occurred due to rapid land degradation and years of complete drought. Aborigines had been settled in Australia for over 40,000 years prior to European settlement and had worked out solutions to the continent's daunting environmental problems – they did not farm but hunted or gathered food.

(Adapted from G. Pickup, *Desertification and climate change – the Australian Perspective*, Climate Research Dec 1998 and from J. Diamond, *Collapse: How Societies Choose to Fail or Survive*, chapter 13.)

Bourke, in the parched west of New South Wales, has been pushed to breaking point by six years of drought, the worst 'big dry' since the white settlement of Australia in 1788. The town relies on irrigation to water the cotton fields and citrus plantations that surround the town. The town's lifeblood has been reduced to a trickle by the lack of rain. There has been no cotton crop for three years and the citrus orchards are withering. Some pastoral farmers are just giving up and moving. Darren Wykes left his wheat and cattle farm to work as a technical skills instructor. "You just can't make any money. We've had a gutful of it. My dad's still on the farm, flogging himself to death". When farming families have no money or move, local towns suffer. Businesses close down, jobs are lost and more families move away. The drought has prompted an intense debate in Australia about whether some areas are becoming too dry for farming.

(Adapted from *The New Zealand Weekend Herald*, 11 November 2006.)

"*Ruins of the building lie amid the ruins of one person's dream.*"

– An image created showing drought and desertification in Australia. (Based on Midnight Oil's album 'Diesel and Dust'.)

Can Australia be "drought-proofed"?

Some people in Australia have suggested forcing rivers to flow inland instead of to the sea. Environmentalist and 2007 'Australian of the Year' Tim Flannery is critical of these ideas. He argues that increasing drought is now a fact of life in Australia and people need to manage this reality. Flannery explained "the idea we could turn rivers inland is a European way of thinking. We've got to become Australian … we are the ones who have got to change".

Ideas for responding in an 'Australian way' to drought and desertification in the future include:

- Retire from farming the areas that suffer from "prolonged drought and require continual government grants' … or tie drought relief to the switch to ecologically sustainable methods of production.
- Retain native vegetation systems. They are more resilient to drought than introduced European species. Landowners know which plants perform best when drought occurs. If these species are preserved the soil, water and wildlife all benefit. This is good and sustainable land management.
- Adopt farming practices that suit the dry Australian environment and stop trying to adapt the landscape to suit European farming. Cattle, sheep, wheat and cotton are a problem in drier areas of Australia. Farmers often respond to drought by irrigating more and clearing more native vegetation to maintain their farming. This causes more problems. Sustainable farming systems suited to the Australian environment are needed. Kangaroos, for example, require just 10% of the water sheep do.

Drought has caused huge stock losses

Catastrophe: Farmer Ian Shippen stands in a dying oat crop under an unused mobile irrigation boom on his Moulamein farm about 600 km west of Canberra.

Source: *The New Zealand Weekend Herald*, September 29 2007