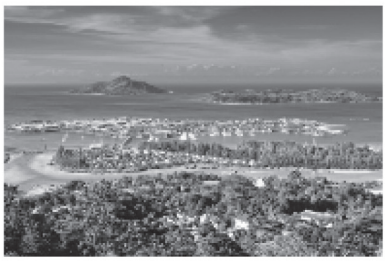
People and the Environment

Only Study Guide for GGH2604

UNISA university of south africa

People and the Environment



Only Study Guide for **GGH2604**

University of South Africa

Printed and published by the
University of South Africa
Muckleneuk, Pretoria

GGH2604/1/2018

Florida

0 PREFACE

Dear Student

Welcome to the module GGH2604: People and the Environment. This module presents you with the complex interrelationships between humans and the environment and how they affect each other on global, regional and local scales. You will also explore measures that can be taken to reduce environmental degradation. Particular attention is also given to the human-environment relationship in Africa.

We trust that you have already received and studied Tutorial Letter 101 to familiarise yourself with the content and structure of the module GGH2604. This study guide comprises of learning units (which are also available under Learning Units on myUnisa) that correspond to the chapters in your prescribed book by Whitehead (2014). Every learning unit is based on a chapter of the prescribed book. The study guide consists of eight learning units. You should systematically work through this study guide and complete all the activities. This will help you to understand the content. Your success in GGH2604 depends largely on your use of the prescribed book. The prescribed book is an essential resource for your assignments as well as your examination. The module is structured around eight learning units that are designed to guide you through the prescribed book.

The material in each learning unit corresponds to the learning outcomes and is based on the prescribed book. The prescribed book for this module is:

Whitehead, M. 2014. *Environmental Transformations: A geography of the Anthropocene*. London: Routledge. ISBN: 9780415809832.

The following subheadings will guide you through the study material:

Reading activity

The chapter, case studies and other specific sections you need to study are indicated under this subheading.

Reading organiser

The reading organiser assists you with summarising 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.

Learning unit activity

Learning unit activities are based on specific sections in the prescribed book, reading organiser or case studies; they are included at the end of each section of the learning unit. Ensure that you do each activity before you proceed with the next section of the study material.

Reflection activity

Reflection activities require you to work through a specific section in a learning unit and reflect on how a situation may manifest itself in your own environment. This may also include questions based on your own personal opinions and values.

Keystone activity

At the end of each learning unit, you have to complete a keystone activity, which aims to capture several important sections of a learning unit into one holistic question.

Sources to consult

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

- **Atlas:** For this module, you may use any recently published (2014 onwards) secondary school level atlas or Google Earth to find the locations referred to in a specific learning unit.
- **Prescribed book:** Whitehead, M. 2014. *Environmental Transformations: A geography of the Anthropocene*. London: Routledge.
- **Case Study:** Case studies are practical examples of the theoretical concepts explained in the prescribed book. Additionally, they also contain information on how human activities affect the environment on the African continent.
- **Additional resources on myUnisa:** Resources enhancing the information contained in the study guide and prescribed book are uploaded under Additional Resources on myUnisa. Of these resources, YouTube videos, Podcasts and PowerPoint documents are the most important.

LEARNING UNIT 1: GEOGRAPHY IN THE ANTHROPOCENE

Sources to consult:

- **Atlas:** The location of Indonesia, Malaysia, the Pacific Ocean, Pripyat, Ukraine, and Lake Chad in West Africa.
- **Prescribed book:** Chapter 1: Introduction: Geography in the Anthropocene, pages 1–14 in Whitehead (2014)
- **Case studies:** 1.1 and 1.2
- **Additional resources on myUnisa:** YouTube video, Podcast and PowerPoint

1.1 INTRODUCTION

The complex interrelationship between humans and the environment lies close to the heart of the discipline of geography. Geography also offers a unique perspective on how human activities affect and influence ecological processes at different scales. The widespread occurrence of pollution and presence of artificial radioactive particles are regarded as evidence that we are now living in the age of man – the Anthropocene. While Zalasiewicz et al (2016:5) argues that "sufficient evidence exists to suggest that the Anthropocene is a real geological phenomenon, with potential to be formalized within the Geological Time Scale", there is still debate around this concept and the proxies used to determine the onset of this epoch.

In this learning unit, we will explore the concept of the Anthropocene along with some of its suggested proxies and examine the role of geography in understanding environmental issues.

1.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to

- explain the concept of the Anthropocene
- identify and explain the basic linkages between human activities and environmental degradation
- discuss how human activities on a local scale can have regional and global consequences

1.3 MEME OR GEOLOGICAL EPOCH: INTRODUCING THE ANTHROPOCENE

Reading activity

Study the section "Meme or Geological Epoch: Introducing the Anthropocene" on pages 1–5, and Box 1.5 on page 10 in Whitehead (2014).

Read Case Study 1.1.

Case Study 1.1

Plastic pollution in the oceans

Zalasiewicz et al (2016:5) estimate that the total amount of plastic generated in 2015 "is of the order of 5 billion tons, which is enough to wrap the Earth in a layer of cling film, or plastic wrap. The current global annual production represents ~40 kg of plastics produced annually for each of the 7 billion humans on the planet". Plastics have found their way into rivers and the oceans in recent decades. The presence of plastics in the oceans has led to the suggestion that this may be used as a geological proxy of the Anthropocene epoch. "Plastics are already present in sufficient numbers to be considered as one of the most important types of 'technofossil' that will form a permanent record of human presence on Earth" (Zalasiewicz et al 2016:15).

In their research on bioaccumulation, Jamieson et al (2017) found unusually high levels of persistent organic pollutants (POPs) in amphipods (crustaceans such as sand fleas) in two of the deepest parts of the oceans – the Mariana Trench in the North Pacific Ocean and the Kermadec Trench in the South Pacific Ocean. Both of these trenches are more than 10,000 meters deep and are considered as some of the most inaccessible and remote parts of the Earth. Amphipods in the Mariana Trench accumulate POPs from its close vicinity to the Great Pacific Garbage Patch. The degradation of plastic debris from the garbage patch assists in the transport of POPs to the ocean floor (Jamieson et al 2017).

Reading organiser

The term "Anthropocene" is made up from the prefix "anthropo" (humankind) and the suffix "cene" (a geological epoch) and can also be referred to as "the age of humans". According to Crutzen, we are now living in the Anthropocene which is characterised by greenhouse gas emission levels, control of water resources, sulphur dioxide emissions, overexploitation of fisheries, fertilizer use and mining activities.

Scientists remain uncertain if the human impact on the environment can be regarded as a geological level shift in planetary history. The fact that the International Commission on Stratigraphy is considering the Anthropocene's scientific validity suggests that something profound has happened in human-environment relationships. A few ethical implications have arisen around the concept of the Anthropocene (consult Box 1.2 on page 5).

Ocean currents in the North Pacific Ocean have produced two huge trash vortexes made up of human waste products (consult Box 1.5 on page 10 and Case Study 1.1). Trash vortexes have been linked to the death of approximately 1 million seabirds every year and 100,000 marine mammals.

Learning unit activity

- Explain the concept of Anthropocene.
- Provide reasons for Crutzen's argument that the Holocene epoch is an outdated marker for the geological time period in which we now live.
- Describe the ethical issues surrounding the concept of Anthropocene with specific reference to geoengineering.

- Give a short explanation on how human activities can lead to environmental degradation.

Reflection activity

- The government of the United Kingdom (UK) aims to prohibit the use of plastic microbeads (also known as polyethylene**,** polypropylene and polymethylmethacrylate) in cosmetics, toothpaste and facial scrubs from the end of 2017 in order to prevent small plastic materials from entering the oceans (BBC News 2016). Levies on plastic bags were introduced in South Africa in 2003 to reduce the levels of plastic bag litter in the country (Naidoo 2017).
    - Do you make use of any products with plastic microbeads in your daily life?
    - Would you consider buying alternative products which do not contain any plastic microbeads?
    - In your opinion, can plastic pollution be used as an indicator for the Anthropocene era?
    - Do you buy plastic bags when you buy groceries?

1.4 THE ROUGH GEOGRAPHIES OF THE ANTHROPOCENE

Reading activity

Study the section "The rough geographies of the Anthropocene" on pages 5–9 in Whitehead (2014).

Read Case Study 1.2.

Case Study 1.2

Pripyat, Ukraine

The use of nuclear power plants for energy generation is often propagated as “safe” or “emitting less pollution” and therefore not having a significant effect on the environment. However, the present state of the ghost town Pripyat in Ukraine is a reminder of some of the negative impacts of nuclear energy generation.

“At 01:23 on 26th April 1986 an experiment was started at reactor number 4 of the Chernobyl nuclear power plant (NPP) in northern Ukraine (then part of the USSR). The purpose of the experiment was to investigate reactor safety in the event of failure of the main electricity supply to the plant. Less than a minute after the start of the experiment there was a steam explosion which blew the lid off the reactor and resulted in the largest accidental release of radioactivity into the environment in the history of nuclear power production. The exposed reactor core continued to burn for approximately 10 days with continued releases of radioactivity to the atmosphere over this period. As well as huge contamination in the local area, a radioactive plume was transported over large areas of Europe with the highest depositions of radioactivity at distances from the NPP being due to wet deposition in rainfall” (Beresford et al. 2016:38).

"The immediate result was significant ecological harm due to the spread of radioactive ions in the environment, 400 times more than the Hiroshima and Nagasaki nuclear bombs. Within a few days hundreds of thousands of people were evacuated from the most contaminated areas around Chernobyl. Most of the evacuees were residents from the nearest town to Chernobyl, Pripyat, which later became known as a 'ghost town'. The residents were misinformed by the Soviet government about the accident and were promised to be allowed to return within a few days and hence left all their personal belongings in their homes but were never allowed to return once the scale of the disaster was recognised. The negative health impacts (cancer, leukaemia, circulatory diseases and other chronic diseases) have so far claimed 600,000 lives of people in the contaminated zones. The most radioactively contaminated area around the Chernobyl power plant was officially designated as The Chernobyl Nuclear Power Plant Zone of Alienation, known as the 'Chernobyl Exclusion Zone' or the 'Zone', located in the northern territory of Ukraine. The exclusion zone extends approximately 30 km in radius from the Chernobyl nuclear reactor and covers around 2600 km^2 of the Ukrainian mainland. It includes the most visited tourist places of Chernobyl city, the town of Pripyat and roughly 180 villages that were evacuated and placed under the military control due to the disaster" (Yankovska and Hannam 2013:929-930).

"After the accident, the deposition of radioactive iodine contaminated agricultural plants, grazing animals, and thus the milk produced in parts of Belarus, Russia, Ukraine and some other parts of Europe. This direct deposition on plants was of most concern during the first two months after the accident since radioactive iodine decays quickly. After this early phase of deposition, an increasingly important concern was plant contamination through absorption of radioactive materials, such as caesium and strontium, from the soil through their roots. Following the accident vegetation and animals in forests and mountain areas have shown particularly high uptake of radiocaesium (137-Cs), with the highest recorded 137-Cs levels found in forest food products. This is due to the persistent recycling of radiocaesium particularly in forest ecosystems. Particularly high 137-Cs activity concentrations have been found in mushrooms, berries, and game, and these high levels have persisted for two decades" (UN Chernobyl Forum 2006).

Livestock, reindeer, mountainous and forest regions in Norway were still affected by exposure to soil which had been affected by radioactive 137-Cs particles from the Chernobyl accident by the year 2013. This has led to the contamination of meat and milk (Gjelsvik and Steinnes 2013).

Reading organiser

Scientists are debating about the events which mark the start of the Anthropocene epoch. The origin of the Anthropocene has been linked to the human domestication of animals, the start of agriculture as well as the rise of nuclear technology and the radioactive traces it left in the geological record.

Geographical perspectives on environmental change are important as they supplement historical accounts of ecological transformation and assist with understanding the consequences of environmental change. A geographical perspective on the Anthropocene explores the ways in which globally significant forms of environmental change affect different places and different people in different ways.

We often think about environmental issues in relation to interconnected global systems, yet we cannot only consider environmental problems on a global scale alone. There is an unevenness of our environmental fates and one example of this is climate change.

Studies indicate that the areas that are most likely to suffer the worst impacts of climate change are Africa and South Asia. Ironically, these areas are some of the places that are the least responsible for the creation of the climate change problem and are least able to protect themselves from its impacts.

Palm oil is an edible extract of palm trees, which is used in the production of a number of everyday products ranging from margarines to cosmetics. By 2010 and 2011 palm oil topped the global vegetable oils production list. In countries such as Indonesia and Malaysia large swathes of rainforest have been cleared and peat wetlands drained in order to make way for palm oil plantations. The example of palm oil illustrates that within the Anthropocene it is important to recognise the lines of geographical connection that join supermarkets in the United Kingdom (UK) with peat swamps in Indonesia, and the cooking and eating practices favoured in the United States (US) kitchen with global climatic change.

Examples of how human activities have impacted on the environment are:

- The ghost town of Pripyat in Ukraine (and the effects of the Chernobyl nuclear disaster there)
- Malakoff Diggins in California (and the impacts of large-scale hydraulic mining)
- The Aral Sea in Kazakhstan and Uzbekistan (and its gradual retreat and desiccation)
- The community of Bhopal, India (and the associated consequences of industrial catastrophes)

Read about the consequences of the Chernobyl accident in Case Study 1.2.

Learning unit activity

- Provide reasons for the debate on the exact time when the Anthropocene begun.
- Describe the role of geography in the understanding of environmental issues.
- Evaluate the following statement: "…although we live in an interconnected biosphere, we experience very different ecological fates" (Whitehead 2014:7).
- Discuss how human activities on a local scale can have regional and global consequences.
- Briefly explain the purpose of the Spaceship Earth metaphor.
- Explain how the use of nuclear power generation can result in severe environmental degradation.
- Identify seven (7) events which illustrate the linkages between human activities and environmental degradation.

Reflection activity

- According to Carolyn Merchant, the two opposing environmental worldviews should be viewed together as a means of leading to environmental recovery (Consult Box 1.3 on page 6 in Whitehead).
    - Which worldview do you support the most: The human mastery of nature (technocentrism) or the deep green environmental care (ecocentrism) worldview? Give reasons for your answer.
    - If you agree with Carolyn Merchant's arguments give reasons for your answer.
- In your opinion, which event marked the beginning of the Anthropocene epoch?
- In your opinion, why is it important to view environmental issues from a geographical perspective?
- Make a list of products you buy on a monthly basis at the grocery store with palm (vegetable) oil as one of the ingredients.
- According to Willsher (2016) "…none ever returned to live in Pripyat, declared too radioactively dangerous for human habitation for at least 24,000 years". If a nuclear disaster takes place at the Koeberg nuclear power plant (in South Africa), do you think Cape Town will become a ghost town like Pripyat?
- Do you think the Chernobyl accident is an example of the dangers of an extreme technocentric approach to the environment?

1.5 KEYSTONE ACTIVITY

"Plastics are already present in sufficient numbers to be considered as one of the most important types of 'technofossil' that will form a permanent record of human presence on Earth" (Zalasiewicz et al 2016:15). Write an essay in which you discuss whether the human impact on Earth has been so profound that we are now living in the Anthropocene Epoch.

1.6 CONCLUSION

In this learning unit we have explored the term "Anthropocene" and looked at a few events which can be considered as markers or proxies for this geological period – the age of man. One of these proxies – the disappearance of Lake Chad – is discussed in the paragraphs below.

"Lake Chad, once one of the African continent's largest bodies of fresh water, has dramatically decreased in size due to climate change and human demand for water. Once a great lake close in surface area to North America's Lake Erie, Lake Chad is now a ghost of its former self. According to a study by University of Wisconsin-Madison researchers, working with NASA's Earth Observing System program, the lake is now 1/20th of the size it was 35 years ago.

Found at the intersection of four different countries in West Africa (Chad, Niger, Nigeria, and Cameroon), Lake Chad has been the source of water for massive irrigation projects. In addition, the region has suffered from an increasingly dry climate, experiencing a significant decline in rainfall since the early 1960s.

The most dramatic decrease in the size of the lake is shown in the fifteen years between January 1973 and January 1987. Beginning in 1983 the amount of water used for irrigation

began to increase. Ultimately, between 1983 and 1994, the amount of water diverted for purposes of irrigation quadrupled from the amount used in the previous 25 years" (NASA Earth Observatory, 2012).

The disappearance of Lake Chad serves as a crucial reminder that human activities on a local scale can have regional (desertification) and, even global, impacts (climate change). It is therefore essential to consider the human-nature relationship from a geographical perspective in order to determine whether we have indeed entered the Anthropocene epoch.

References:

BBC News. 2016. *Plastic microbeads to be banned by 2017, UK government pledges*. Available from: http://www.bbc.co.uk/news/uk-37263087. [Accessed on: 29 March 2017].

Beresford, N.A., Fesenko, S., Konoplev, A., Smith, J.T., Skuterud, L. and G. Voigt. 2016. Review: Thirty years after the Chernobyl accident – 30 key papers published in the Journal of Environmental Radioactivity. *Journal of Environmental Radioactivity 157,* 38-40.

Gjelsvik, R. and E. Steinnes. 2013. Geographical trends in 137Cs fallout from the Chernobyl accident and leaching from natural surface soil in Norway. *Journal of Environmental Radioactivity 126*, 99-103.

Jamieson, A.J., Malkocs, T., Piertney, S.B., Fujii, T. and Zhang, Z. 2017. Bioaccumulation of persistent organic pollutants in the deepest ocean fauna. *Nature Ecology & Evolution 1*, 0051, 1-3.

Naidoo, R. 2017. *DEA looking into plastic bag manufacturers*. Available from: http://www.infrastructurene.ws/2017/04/19/dea-looking-into-plastic-bag-manufacturers/#. [Accessed on: 8 May 2017].

NASA Earth Observatory. 2012. The Aral Sea, Before the Streams Ran Dry. Available from: https://www.theguardian.com/cities/2016/mar/07/chernobyl-30-years-residents-life-ghost-city-pripyat. [Accessed on: 29 March 2017].

UN Chernobyl Forum. 2006. *Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts*. Austria: IAEA (International Atomic Energy Agency).

Willsher, K. 2016. Chernobyl 30 years on: former residents remember life in the ghost city of Pripyat. Available from: https://www.theguardian.com/cities/2016/mar/07/chernobyl-30-years-residents-life-ghost-city-pripyat. [Accessed on: 29 March 2017].

Yankovska, G. and K. Hannam. 2014. Dark and toxic tourism in the Chernobyl exclusion zone. *Current Issues in Tourism 17*, 10, 929-939.

Zalasiewicz, J., Waters, C.N., Ivor do Sul, J.A., Corcoran, P.L., Barnosky, A.D., Cearreta, A., Edgeworth, M., Galuszka, A., Jeandel, C., Leinfelder, R., McNeill, J.R., Steffen, W., Summerhayes, C., Wagreich, M., Williams, M., Wolfe, A.P. and Yonan. Y. 2016. The geological cycle of plastics and their use as a stratigraphic indicator of the Anthropocene. *Anthropocene 13*, 4-17.

2 LEARNING UNIT 2: POPULATION GROWTH AND RESOURCE USE

Sources to consult:

- **Atlas:** The location of Saudi Arabia, Kuwait, Iraq, Iran, the United Arab Emirates, China, Libya, and the Nile River in Africa.
- **Prescribed book:** Chapter 2, "Resources: oil and water", on pages 17-41 in Whitehead (2014)
- **Case Study 2:** Unconventional oil and gas extraction in South Africa
- **Additional Resources on myUnisa:** YouTube video, Podcast and PowerPoint

2.1 INTRODUCTION

Population growth and increases in the use of certain resources are key factors which are constantly at play in the Anthropocene Epoch. These factors, along with the demise of ancient societies, have sparked many debates over the centuries and led to the development of various theories and perspectives to explain the relationship between them. Prominent perspectives on the population growth-resource use relationship are Malthusian, Neo-Malthusian, Cornucopian, Peakist and Marxist. Some of these theories complement each other, while others are almost opposites. These theories provide an important understanding of how complex the human-environment relationship is and why it is important to view different issues from different geographical scales.

In this learning unit we will take a look at the consumption of minerals, prospects for exploiting oil and gas reserves, population growth theories and resource scarcity. Case studies highlight the causes and consequences of mineral consumption, population growth and resources scarcity in South Africa and along the Nile River Basin (stretching from Central to Northern Africa).

2.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to

- discuss how the consumption of minerals affects the environment
- describe the causes and consequences of unconventional oil and gas extraction
- compare and evaluate various population growth theories and discuss how population growth affects the use of resources
- explain how population growth and resource consumption contribute to resource scarcity

2.2 THE SIMON-EHRLICH WAGER

Reading activity

Study the section “Introduction: The Simon-Ehrlich Wager” on pages 17-19 in Whitehead (2014).

Reading organiser

Paul Ehrlich predicted that rising levels in the global population would lead to shortages in the availability of resources (such as food and energy) and significant forms of human suffering. Julian Simon claimed that population growth did not lead to resource scarcity.

Ehrlich is associated with a Malthusian worldview which suggests that in the context of rising population levels and the increasing demand for resources, finite resources will eventually be exhausted. Simon, by contrast, holds a cornucopian outlook. Cornucopians believe that technologies and market forces will work to ensure that in the future humans will have enough resources to meet their collective needs. Figure 2.1 below depicts an example of a cornocupia. The word “cornucopian” is derived from Greek and can also be referred to as the “horn of plenty”.

Figure 2.1: An example of a cornucopia.

Learning unit activity

- Discuss the Simon-Ehrlich wager.
- Compare the two worldviews which are used to explain the arguments used by Paul Ehrlich and Julian Simon.
- Describe the main beliefs of the cornucopian worldview.

2.4 CHANGING PATTERNS OF RESOURCE USE

Reading activity

Study the section "Changing Patterns of Resource Use" on pages 19-31 in Whitehead (2014).

Read Case Study 2.

Case Study 2

Unconventional oil and gas extraction in South Africa

Figure 2.2 below shows the unconventional oil and gas extraction process known as hydraulic fracturing (fracking). During this process, water (or other fluids) under high pressure is injected into the gas and oil reserves below the earth's surface and are subsequently extracted from these reserves (Park and Allaby 2017).

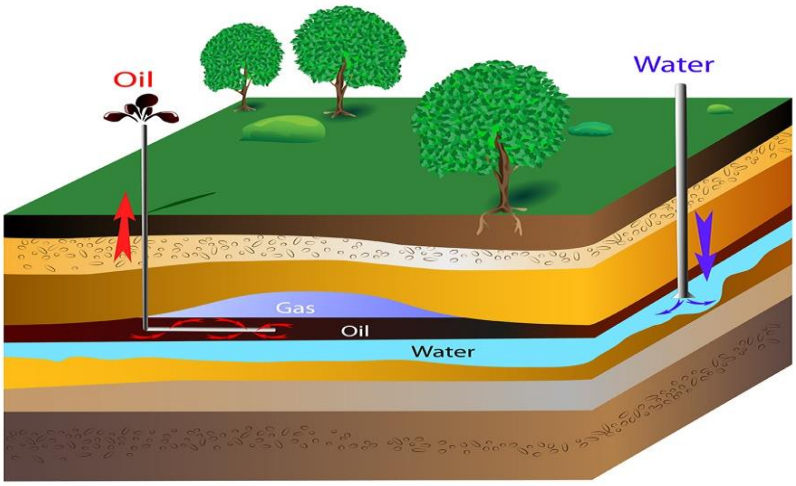


Figure 2.2: Hydraulic fracturing

"The growing demand for energy challenges economic development in South Africa. The South African population is predicted to grow from 50.6 million currently to 58.5 million by 2030. Migration from neighbouring countries could push this number up to 61.5 million, driving the need for energy, jobs and food security. By 2030, at least 29,000 MW of

additional electricity will be required to cater to South Africa's growing energy needs; and with 10,900 MW of capacity due to be retired by then, new builds of more than 40,000 MW will be required.

In light of this the government has decided to proceed with the exploration and extraction of unconventional oil and gas (UOG) resources. Another concern driving the current focus on UOG are carbon emissions. Of the world's countries, South Africa is the twelfth-largest carbon emitter because its energy-intensive economy is currently heavily dependent on carbon-based fuels. UOG is viewed as a transitional fuel that could, in the long term, assist in reducing carbon emissions because shale gas has a lower carbon footprint than coal, producing less greenhouse gas emissions per MWh of electricity than coal. The first exploration licences have been awarded in South Africa and exploratory drilling could commence, depending on timeframes for obtaining environmental authorizations, while full-scale extraction of the resources may take longer and would depend on the economic viability of extracting the resources. In addition to the above energy constraints, South Africa is also a water-stressed country, placing additional challenges on future economic development. The country receives an average rainfall of 497 mm per year, well below the global terrestrial average of 860 mm, and has annual freshwater availability of approximately 1000 m^3 per person per year.

UOG extraction and the management of its related impacts are controversial in many countries worldwide, such as Canada, France, the US and the UK. Any of the activities associated with UOG extraction might seriously impact both the biophysical and the socio-economic environments. For example, while oil and gas exploration and extraction may enhance socio-economic development in certain areas through increased primary and secondary employment opportunities, environmental impacts such as depletion of water sources, water contamination and seismicity may impact on community health and safety, and food security for the poorer sectors of these communities. Water requirements for each shale production well may range widely, with reported usage of between 10,000 m^3 and 30,000 m^3 of water for the fracking procedure, excluding ancillary water requirements such as for sanitation and dust suppression. Water requirements for coalbed methane are generally lower than for shale oil and gas operations, but wastewater management becomes more challenging. There is, therefore, an inextricable link between water availability and energy resource development. Water is required for the development of energy, but energy is also required to secure, deliver, treat and distribute water (Scott et al., 2011; Siddiqi & Anadon, 2011).

In its effects on both surface water and groundwater quality and quantity, sourcing of water for fracturing operations could impact water availability. In South Africa, some 300 towns and over 65% of the population are fully reliant on groundwater sources for domestic uses. UOG extraction and its related activities (vegetation clearing for well pad construction, access roads, and pipelines) may furthermore have direct impacts on vegetation, with an associated loss of biodiversity. Degraded ecosystems are unable to persist in the face of the extensive ecological footprints of gas industries, especially when the impact is compounded by factors such as climate change. The provision of ecosystem

goods and services may also significantly decrease in South Africa's low rainfall, arid environment.

The scale of the impacts of UOG extraction spans both spatial and temporal dimensions and is cumulative. On a spatial scale, UOG extraction does not occur only within specific geographic boundaries, as is the case for localized mining operations, but includes an array of gas well sites that may cover vast geographic expanses. In South Africa, current oil and gas exploration applications cover almost half of the surface area of the country. Apart from the specific geographic location where oil and gas are extracted, a wider expanse of surface area is usually impacted by the connecting roads, processing plants and pipelines that serve to process the product and transport it to the end user. Therefore, environmental and socio-economic impacts may cross provincial or other boundaries, such as catchments or municipal limits, in ways that localized mining operations usually do not. This may complicate efforts to coordinate integrated resource management to protect resources such as water or livelihoods. It also makes the development of UOG extraction regulatory policy for water and other resources quite complex. In some instances, UOG extraction impacts can even cross international political borders" (Esterhuyse et al. 2016: 409-417).

Reading organiser

Affluent nations of the OECD (Organization for Economic Co-operation and Development), such as the UK, USA and Germany, have been the dominant consumers of global energy. The OECD share of global energy use is decreasing due to the rapidly expanding economies such as China and India.

The geography of mineral energy extraction and use is complicated by the location of oil reserves. Given the concentration of oil reserves in the Middle East, it is no surprise that the region is very significant in terms of geopolitics.

Examples of products which have caused an increase in the consumption of mineral resources:

- Hydraulic cement used for buildings
- Iron ore used in construction and infrastructure projects
- Metals with high levels of conductivity (such as copper) are used in the production of electrical products
- The metal nickel is used in the production of stainless steel, rechargeable batteries, coins and even electric guitar strings

- Gold necklaces
- Mobile phones
- iPads

Open cast or strip mining can destroy landscapes and the ecological systems that have developed upon them. The removal of minerals from the ground may release pollutants into the environment. The spoils from mining activities often contain substances such as mercury and arsenic. When rainwater passes over the mining spoils it can transport these pollutants into surrounding watercourses.

The rapid increase in the prices of rare earth metals in 2010 and 2011 was not a product of scarcity, it was a result of China's cornering of the market. China produces approximately 95% of all rare-earth metals on the global market. The price hike of 2010/2011 was a product of China's decision to restrict its export of rare earth metals.

Learning unit activity

- Compare the patterns of mineral and energy extraction and use on a regional scale (consult Figure 2.4 on page 21).
- Describe the causes for and consequences of the possible exploitation of unconventional oil and gas extraction (fracking) in South Africa (also consult Box 2.1 on page 23).
- Explain why the exploitation of energy resources is not limited to local scales only.
- Provide examples of products which have caused an increase in the consumption of mineral resources.
- Discuss the consequences of mining on the environment.
- Evaluate this statement: "The example of rare earth metals reminds us that price alone is an unreliable indicator of absolute resource scarcity" (Whitehead 2014:27).
- Compare the average levels of water consumption on a global scale to the average per capita water use in Australia and the US.
- Describe the water scarcity situation on the African continent according to Figure 2.9.

Reflection activity

- Esterhuyse et al. (2016: 409) argue that, "Of the world's countries, South Africa is the twelfth-largest carbon emitter, because its energy-intensive economy is currently heavily dependent on carbon-based fuels. UOG is viewed as a transitional fuel that could, in the long term, assist in reducing carbon emissions..." In your opinion, is the exploitation of UOG resources an effective way of reducing South Africa's carbon footprint?
- According to Whitehead (2014), the average global consumption of water per capita (per person) is approximately 100 litres per day. How many litres of water does your household consume per day?

2.5 DOOMSTERS, CORNUCOPIANS AND EVERYTHING IN BETWEEN

Reading activity

Study the section “Doomsters, Cornucopians and everything in between” on pages 31-37 in Whitehead (2014).

Reading organiser

Malthus argued that population growth would lead to food shortages and hunger, and increases in human conflict and war for control over scarce resources. He also predicted that checks would be placed on human population growth – positive checks (birth control and smaller sized families) and negative checks (increases in death rates). Many people still support Malthus’s theory – they are called neo-Malthusians. Neo-Malthusians believe that there are real limits in the biosphere’s ability to supply resources and absorb the pollution associated with resource extraction. Neo-Malthusian researchers in Massachusetts, US (often referred to as the *Club of Rome*), published their views – that economic development would be severely restricted if levels of population growth and resource use continued to expand - in the *Limits to Growth* report.

Cornucopians believe that increases in population lead to the discovery and development of more resources (Boserup) and that the operations of the free market can help humanity avoid serious resource shortages (Chicago Boys). The work of Ester Boserup is considered as one of the most important challenges to Malthus’s theory.

Hubbert predicted that oil production in the US would reach a peak during the early 1970s. He also predicted that the global production of oil would reach a peak around 1995, after which point the supply of oil would enter a terminal pattern of long-term decline. While Hubbert’s prediction about the US peak oil production was accurate, his global prediction was less reliable. Many “peakists” have argued that Hubbert’s curve could be applied to a range of other resources.

Marxists claim that Malthusian concerns with resource shortages fail to recognise that there are often enough resources. From a Marxist perspective, resource scarcity occurs since wealthy owners of a given resource tend to overexploit them for their own gain – by selling harvests to overseas markets, or placing oil revenues in overseas bank accounts. Marxists are also critical of the corncucopian claim that the free market provides the basis for enhancing resource production, since they argue that it is the free market systems that are causing social and environmental problems.

Le Billon’s work illustrates that there is no simple connection between resources and conflict. Resource scarcity is not the only driver of conflict – the desire for power and wealth are strong motivators. The type of conflict that emerges around resources is caused by the economic and political situation of a geographical region.

Learning unit activity

- Compare various population growth theories and discuss how they affect the use of resources.
- Evaluate the Malthusian and cornucopian perspectives on population growth and resource use from a Marxist perspective.
- Briefly describe the causes of resource overexploitation according to eco-Marxists.

- Describe the role of geography in resource scarcity and conflict according to Le Billon (Box 2.4).

Reflection activity

- "…Kaplan argued that rising population levels and resource scarcity were leading to hunger and conflicts over scarce resources in regions such as West Africa" (Whitehead, 2014: 32). Do you agree with this argument? Motivate your answer.
- To what extent do you agree or disagree with the Marxist claim that the neoliberal (free market) system lies at the heart of environmental problems? Motivate your answer.

2.6 WATER RESOURCES IN THE NILE BASIN

Reading activity

Study the section "Water resources in the Nile Basin" on pages 37-40 in Whitehead (2014).

Reading organiser

Population growth along the Nile Basin have placed strain on the ability of the river system to deliver adequate supplies of water. In 1950 there were approximately 60.5 million people living in the Nile Basin. By 1998 this figure had increased more than threefold to 206.6 million people. As upstream states (Ethiopia, Sudan and South Sudan) build more dams and irrigation schemes on the Nile, downstream state Egypt is becoming concerned about its own ability to extract more water from the Nile. Water withdrawals in Egypt and Sudan from the Nile and its tributaries are governed by the *1959 Nile Waters Agreement*. This agreement limits the amount of water that each state can withdraw from the river system in a year: Sudan may withdraw 18.5 billion cubic metres and Egypt 55.5 billion cubic metres annually. In the recent past, when Sudan has suggested that it would withdraw more water from the Nile, Egypt threatened to use force to prevent it.

It is important to note that in 1999, the Nile Basin Initiative (NBI) was established to compile the Cooperative Framework Agreement (CFA) which involves countries along the Nile River Basin. According to the NBI (2017) "…rather than quantifying 'equitable rights' or water use allocations, the Treaty intends to establish a framework to 'promote integrated management, sustainable development, and harmonious utilization of the water resources of the Basin, as well as their conservation and protection for the benefit of present and future generations'". By 2017, only the upstream states of Ethiopia, Rwanda, Tanzania, Uganda, Kenya and Burundi had signed the agreement. These countries would like to extract water for agricultural purposes and hydroelectricity since they were prevented from extraction in the past by Egypt. Egypt has been refusing to sign the agreement which will reduce the amount of water it is allowed to extract from the Nile (Aman 2017; Mulisa 2017).

The example of the Nile Basin appears to lend itself to a Malthusian interpretation: As population growth outstrips the supply of resources such as food and water, society will be subjected to severe limits to its development and conflicts over scarce resources. The fact that population has continued to grow so rapidly in the Nile Basin suggests that there might be merit in the cornucopian perspective. In this context, it could be argued that population

growth and the pressure to withdraw more water from the Nile River system have led to the development of technological solutions, including the construction of dams and innovative irrigation schemes that have enabled continued economic growth in the region. Marxists point out that when there are droughts in the Nile Basin, it is the poor and not the wealthy that experience water scarcity. In addition, a Marxist perspective would question whether the building of dams and new irrigation systems in the Nile Basin is really solving water scarcity issues or securing water for the most powerful states (such as Egypt).

The water scarcity issues in the Nile Basin reflect two key features of the Anthropocene: Problems associated with the accelerated extraction of resources from the natural environment; and where humans are trying to exert technological control over the natural world through the building of dams and irrigation systems.

Learning unit activity

- Explain how population growth and resource consumption contribute to resource scarcity, with specific reference to water resources in the Nile Basin.
- Provide reasons why the water scarcity issues in the Nile Basin reflect key features of the Anthropocene epoch.

Reflection activity

- "The South African population is predicted to grow from 50.6 million currently to 58.5 million by 2030. Migration from neighbouring countries could push this number up to 61.5 million..." (Esterhuyse et al. 2016:409). Recently, restrictions on water use were introduced in urban areas in South Africa during lower rainfall periods. Do you think South Africa's water scarcity situation is an example of the Malthusian, Cornucopian or Marxist perspective?

2.7 KEYSTONE ACTIVITY

According to Meadows et al. (1972) "…the earth's interlocking resources…probably cannot support present rates of economic and population growth much beyond the year 2100, if that long, even with advanced technology". Write an essay to debate this statement with specific reference to energy and water resources in Africa.

2.8 CONCLUSION

In this learning unit we have seen how population growth and resource consumption are key elements of the Anthropocene epoch. On the one hand, population growth may lead to an increase in resource use and therefore also resource scarcity, while on the other hand economic, political and social variables in different locations may play a bigger part in creating resource scarcity than population growth. In addition, the exploitation of mineral resources may strain our ability to use scarce resources – such as water in water-scarce South Africa – in the near future. The use of water from the Nile River Basin remains a contentious issue, yet it may become one of the proxies used to define the Anthropocene Epoch – an era where humanity sought control over the environment.

References:

Aman, A. 2017. *After seven-year absence, Will Egypt return to Nile Basin Initiative?* Available from: http://www.al-monitor.com/pulse/originals/2017/04/egypt-water-share-dispute-nile-basin-initiative-obstacles.html#ixzz4gxOps4nl. [Accessed on 13 May 2017].

Esterhuyse, S., Redelinghuys, N. and Kemp, M. 2016. Unconventional oil and gas extraction in South Africa: water linkages within the population–environment–development nexus and its policy implications, *Water International 41*, 3, 409-425.

Meadows, DH, Meadows, DL, and Behrens, WW. 1972. *The Limits to Growth: A report for the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books.

Mulisa, H. 2017. *Ethiopia: Cooperation On the Nile - Cornerstone of Win-Win Approach.* Available from: http://allafrica.com/stories/201704020178.html. [Accessed on 13 May 2017].

Nile Basin Initiative (NBI). 2017. Cooperative Framework Agreement. Available from: http://www.nilebasin.org/index.php/nbi/cooperative-framework-agreement. [Accessed on 13 May 2017].

Park, C. and M. Allaby. 2017. *A Dictionary of Environment and Conservation. Third edition.* Oxford: Oxford University Press.

3 LEARNING UNIT 3: AIR POLLUTION AND CLIMATE CHANGE

Sources to consult:

- **Atlas:** Mauna Loa volcano in Hawaii, Los Angeles, Mexico City and London
- **Map 3:** Cities at risk due to sea-level rise.
- **Prescribed book:** Chapter 3, "Air: Science and the atmosphere", on pages 42-64 in Whitehead (2014)
- **Case Studies 3.1 and 3.2:** Climate change in Africa and Climate resilience in Rwanda
- **Additional Resources on myUnisa:** YouTube video, Podcast and PowerPoint

3.1 INTRODUCTION

"Of all the Earth's spheres, the atmosphere is the most transitory. A complex mix of gases and water vapour, it is in a constant state of flux" (Whitehead 2014:53). It is in this context that we study ways in which humans have altered the atmosphere in the Anthropocene: Air pollution and climate change.

Air pollution can have many impacts on not only the environment, but also on human health. In 2016, a six-day photochemical smog event in Dehli, India, saw the closure of schools and a five-day prohibition on construction activities due to the high concentration of particulate matter. The concentration of the particles were so high they could not be measured by air quality instruments (Safi, 2016). Vidal (2016) reported that "Africa's air pollution is causing more premature deaths than unsafe water or childhood malnutrition, and could develop into a health and climate crisis reminiscent of those seen in China and India…".

One of the main environmental impacts of air pollution is its role in altering the climate. Climate change is defined as "any natural or induced change in climate, either globally or in a particular area. Examples include the natural climate change that has caused ice ages in the past, and global warming that many believe is now being caused by rising concentrations of greenhouse gases in the atmosphere" (Park and Allaby 2017).

In this learning unit we will consider the impacts of air pollution and climate change on human health and the environment. As pointed out in Learning Unit 1, Africa will be severely affected by climate change. Therefore, we will explore some of the climate change impacts on Africa and some of its adaptation strategies. In addition, we will highlight the role of science in producing and communicating the ways in which human activities affect the atmosphere.

3.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to

- examine the causes and impacts of human activities on the atmosphere
- discuss the consequences of air pollution and climate change on human life and the environment

- discuss the role of science in identifying and explaining the linkages between human activities and the atmosphere
- describe remedial measures that can be taken to address climate change

3.3 THOMAS MIDGLEY AND THE ULTRAVIOLET CENTURY

Reading activity

Study the section “Introduction: Thomas Midgley and the Ultraviolet Century” on pages 42-44 in Whitehead (2014).

Reading organiser

In 1921 Thomas Midgley discovered that adding lead to petrol could combat the problem of engine knocking in vehicles. While the addition of lead to petrol was beneficial for the operation of vehicles, it resulted in a spike in the levels of lead in the atmosphere. Lead, which is toxic, then entered human bloodstreams and ecological systems. In the 1930s Midgley realised that the use of chlorofluorocarbons (CFCs) could improve the safety of refrigeration, however, CFC production led to a decrease in the planet’s ozone layer. Ozone depletion has been linked to higher levels of skin cancer, plant damage and dwindling plankton populations in the oceans.

Cumulative forms of pollution are forms of pollution that gradually accumulate in the environment over long periods of time, for example the air pollution associated with leaded petrol. Systemic forms of pollution refer to the ways in which certain pollutants can actually change the ways in which large-scale ecological systems (such as the ozone layer) operate.

In the Anthropocene, science and scientists are not only involved in generating atmospheric problems, but also in helping to identify and address them.

Learning unit activity

- Describe how Thomas Midgley’s inventions affected the atmosphere.
- Distinguish between cumulative and systemic forms of pollution.
- Briefly explain the role of science and scientists in the Anthropocene.

3.4 AIR POLLUTION: FROM MAUNA LOA TO MUMBAI

Reading activity

Study the section “A brief history of air pollution: From Mauna Loa to Mumbai” on pages 44-52 in Whitehead (2014).

Reading organiser

Svante Arrhenius discovered the greenhouse effect. The greenhouse effect is a naturally occurring process that is responsible for regulating the Earth’s temperature. Greenhouse gases operate like a planetary blanket which keeps the planet warm and suitable for life.

Without greenhouse gases the Earth's average temperature would dip to -18º Celsius. Examples of greenhouse gases are the following:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Water vapour (H_2O)
- Ozone in the troposphere (O_3)
- Nitrous oxide (NO_x)
- Aerosols (dust and smoke)
- Sulphur hexafluoride (SF_6) (Cook 2012 and Whitehead 2014)

Keeling's work in the thin air of Mauna Loa, Hawaii (3000 metres above sea level), revealed increasing levels of carbon dioxide in the atmosphere. When Keeling started his study, he recorded carbon dioxide at levels of 310 parts per million (ppm). Measurements at the Mauna Loa Observatory in April 2017 recorded the level of carbon dioxide in the atmosphere as 406.17ppm (Tenenbaum et al. 2017). Collectively, Keeling's observations led to the production of the Keeling Curve. The curve shows increasing levels of carbon dioxide in the atmosphere over time. The increase in carbon dioxide levels coincides with studies indicating that average global temperatures have increased by 1.5 degrees Celsius over the last 250 years.

Population growth, the expansion of railways, textile, steel and alkali production industries contributed to the increased combustion of coal and hydrogen chloride emissions which affected the air quality of London from the 17th century.

The combustion of coal and petroleum releases sulphur dioxide (SO_2) and nitrous oxides (NO_x) into the air. These gases react with water molecules to produce sulphuric or nitric acid. Once produced, this acid can be transported over long distances before being deposited on ecosystems – known as acid deposition or acid precipitation. Park and Allaby (2017) explain that "acid precipitation can occur as dry deposition and as wet deposition in the form of rain, drizzle, snow, or mist. Acid precipitation has a pH of less than 5.6, and the deposition of acidic material on the ground causes acidification of soils, water bodies, and vegetation". Acid rain can:

- lead to biodiversity loss
- inhibit the hatching of fish eggs
- weaken trees by attacking their leaves and inhibiting their ability to absorb nutrients
- deplete the soil of nutrients
- damage tree roots
- lead to impaired photosynthesis (Park and Allaby 2017)

Photochemical smogs are a product of sunlight reacting with NO_x and volatile organic compounds (VOCs), which are emitted from vehicular exhausts, producing ground-level ozone and airborne particles. Photochemical smog may affect human health by increasing incidents of asthma, acute respiratory infections, cardiopulmonary disease and cancers of the lungs and trachea. Unlike industrial cities where the cold air of winter associated with high-pressure weather systems trap air pollution, Los Angeles's fog is a phenomenon of the late summer.

Learning unit activity

- Explain how the greenhouse gas effect occurs and which gases contribute to the formation of this phenomenon.
- Discuss the role of Charles Keeling's work in understanding the linkages between human activities and the greenhouse effect.
- Draw the Keeling Curve and explain why there are annual fluctuations in atmospheric carbon dioxide in the Keeling Curve.
- Identify the human activities which led to poor air quality over the city of London and Great Britain from the 17th century onwards.
- Describe the causes of acid rain and its consequences on the environment.
- Explain how photochemical smog is formed and why photochemical smog events in Los Angeles differ from other cities.
- Discuss the consequences of photochemical smog on human health.
- Classify the following types of pollution as cumulative or systemic forms of pollution and enter them in the table below:
    - Lead pollution
    - CFC emissions
    - CO_2 and other greenhouse gas (GHG) emissions
    - SO_2 and NO_x emissions
    - Particulate matter (PM) and volatile organic compounds (VOCs)

Cumulative forms of pollution	**Systemic forms of pollution**

Reflection activity

- Whitehead (2014) expresses doubt about the motivation for cutting funding for Robert Keeling's work. Do you think Whitehead's doubts are justified?
- Have you ever observed photochemical smog in an urban area? If so, did the photochemical smog affect your health?

3.5 REFLECTIONS ON THE NATURE OF ATMOSPHERIC SCIENCE

Reading activity

Study the section "Reflections on the nature of atmospheric science" on pages 52-60 in Whitehead (2014).

Reading organiser

Modern science has two key characteristics – a commitment to objectivity, and a quest for a universal basis for the study of nature. Taken together, the objectivity and universality of modern science are important because they enable the production of more reliable and trustworthy accounts of the real world. A crucial factor within the production of scientific

knowledge is the notion of *scientific consensus*. Scientific research progresses through the development of consensus, in and through which particular ways of understanding the world become accepted wisdom, whereas other theories are rejected. A paradigm is a scientific model that explains how a certain process works. Paradigm shifts occur when two incompatible theories of scientific knowledge contest each other to be the accepted way of explaining how the world works. A paradigm shift could be observed in geography when theories of a flat Earth were rejected.

The objectivity of smoke inspectors in London was compromised due to limited visibility, local terrain issues and interference by factory owners. In addition, the decision to locate the majority of the UK's sulphur dioxide monitoring stations in urban areas led to gaps in scientific knowledge concerning the extent of acid deposition in rural areas.

Recent trends in the scientific knowledge of the atmosphere indicate how scientific knowledge can be deliberately manipulated. While many scientists have raised important questions about the scientific consensus on human-induced climate change, others have sought to deliberately generate a sense of public confusion on the issue. While an estimated 97% of scientists have reached the consensus that the human enhancement of the greenhouse gas effect is responsible for current climate changes, a range of institutions and individuals are trying to cast doubt on the scientific consensus on climate change (Cook 2017). Lewandowsky et al. (2015: 1) argue that "opponents of the scientific consensus on climate change…have often emphasized scientific uncertainty in order to forestall mitigative action. Those arguments often exaggerate, for political or ideological reasons, the actual degree of uncertainty in the scientific community or imply that uncertainty justifies inaction". It has been established that the opponents of the scientific consensus on climate change have received funding from ExxonMobil, the world's largest oil corporation.

In 2001 Danish academic Bjørn Lomborg published a book *The Skeptical Environmentalist* wherein he cast doubt on various scientific predictions that climate change would lead to serious socio-ecological problems in the future. The Danish Committees on Scientific Dishonesty felt that the dishonesty in the book was a product of Lomborg's lack of scientific expertise the field of climate change.

Learning unit activity

- Describe the roles of objectivity, universality, consensus and paradigm shifts in modern science.
- Explain why the objectivity of smoke inspectors in the London County Council were compromised.
- Discuss how the location of air pollution instruments led to a false belief that acid rain did not have a significant impact on rural areas in the UK.
- Describe the attempts by ExxonMobil in deliberately manufacturing scientific uncertainty about climate change.
- Briefly explain why the Danish Committees on Scientific Dishonesty found the book *The Skeptical Environmentalist* contained information that could be regarded as scientific dishonesty.

Reflection activity

- The South African Department of Environmental Affairs (DEA) declared three regions with poor ambient air quality as Air Quality Priority Areas – Waterberg Bojanala Priority Area (Western parts of the Limpopo Province); Vaal Priority Area (Southern Gauteng and Northern Free State Provinces) and Highveld Priority Area (Mpumalanga Province). The air quality of these priority areas is constantly monitored by the DEA. In your opinion, would the monitoring of air quality in priority areas assist with the detection of acid deposition downwind?
- Milman (2016) writes that the head of the US Environmental Protection Agency (EPA) "…sided with Exxon Mobil, which is the subject of an investigation by attorneys general in Massachusetts and New York over claims that it misled investors by covering up its knowledge of climate change". In your opinion, what are the ethical implications of the conduct of the head of the EPA?

3.6 CLIMATE CHANGE IN AFRICA

Reading activity

Read Case Study 3.1: Climate change in Africa and study Map 3: Cities at risk due to sea-level rise.

Case Study 3.1

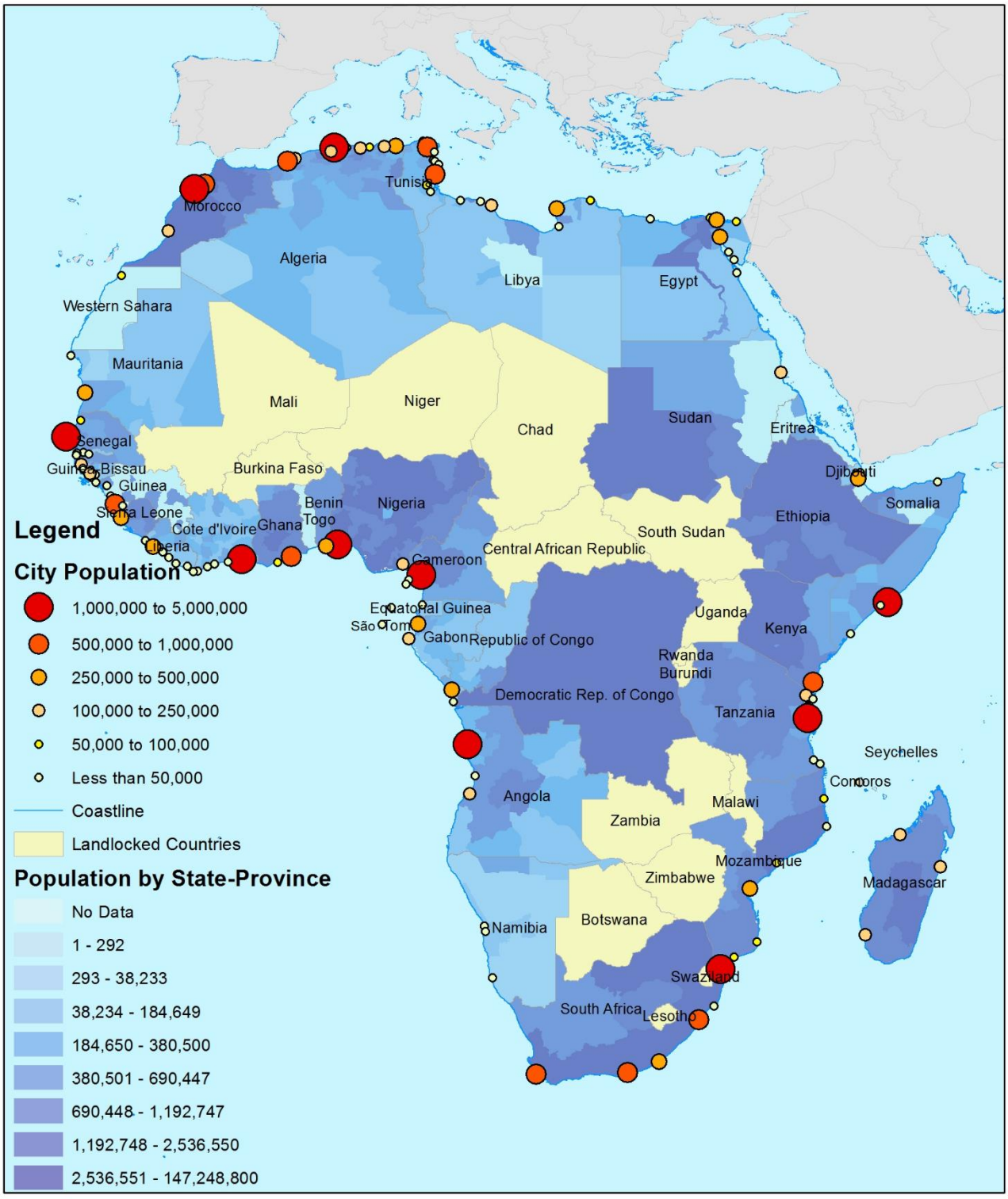
Climate change in Africa

According to UNEP (2016:16), Africa "…is warming faster than the global average, with projections of a rise of 3–4 ˚C this century. This makes climate change a considerable health and economic challenge for the continent. Climate-sensitive diseases such as cholera, meningitis, malaria and Rift Valley fever are likely to spread faster. In some areas, the warming is likely to reduce crop yields and livestock productivity, and cause water scarcity. Extreme weather and climate events such as droughts and floods are expected to be more frequent, with negative impacts on human life and health. Climate change will also lead to wildlife migration due to habitat loss". ECA et al. (2016: 21) add that "Africa is recognized as one of the most vulnerable continents to climate change and climate variability, due to 'multiple stresses' such as endemic poverty, weak governance and institutional arrangements, ecosystem degradation, complex disasters and conflicts, and limited access to capital, infrastructure and technology".

"With projections of sea level rise along Africa's coastal zones by 2100 approximately 10 per cent higher than the global mean (Schellnhuber *et al.* 2013), the coastal wetlands of 37 countries will be vulnerable at various spatial and temporal scales. Densely populated low-lying coastal and estuarine zones, including small islands such as Seychelles, Comoros and Mauritius in the Western Indian Ocean, will be most affected. With a 1-metre sea level rise accompanied by 10 per cent intensification of storm surges, the mangrove areas of Gabon, Cameroon, Guinea, Guinea Bissau and Nigeria and the coastal lagoons of Angola and Ghana, in addition to low-lying coastal urban centres and ports, will be inundated" (UNEP 2016:64). Neumann et al (2015) estimate that Egypt and Nigeria are extremely vulnerable to future rises in sea level. In addition to inundation, coastal regions

may experience coastal erosion, saltwater intrusion and flooding. The situation can be exacerbated by the increase in population growth and urbanisation along coastal regions in Africa (Neumann et al. 2015). Map 3 shows African cities that are vulnerable to sea level rise [Map 3 was adapted from UNEP (2016)].

Cities at risk due to sea-level rise



1 cm = 455 km

N

0 375 750 1 500 2 250 Kilometers

UNISA

Map created by the Geo-Information Office and Map Archive

Learning unit activity

- Discuss the consequences of climate change in Africa on human life and the environment.
- Explain why urban areas along the African coastline are vulnerable to sea level rise.
- Identify the African cities in the Southern Hemisphere which are at risk due to sea level rise.

Reflection activity

- In your opinion, do you think the impacts of climate change are exaggerated?
- Consider the predictions regarding future sea level rise along the coastline of Africa. How do you think a future sea level rise would affect tourism activities in coastal cities?

3.7 ADAPTATION TO CLIMATE CHANGE

Reading activity

Read Box 3.2 on pages 47-48 in Whitehead (2014) and Case Study 3.2.

Case Study 3.2

Climate resilience in Rwanda

"…Brooks et al. (2005), rated Burundi, DRC, Ethiopia and Rwanda as some of the most vulnerable countries in the world to climate change…

Rwanda is a mountainous country in the Great Lakes region of Africa, covering roughly 26,338 km². It is known as the 'land of a thousand hills' as its terrain is characterized by steep slopes and green hills. Its predominantly rural population relies on subsistence agriculture for livelihoods. According to the 2012 population census, Rwanda has a total population of 10,537,222, giving a population density of 416 people per km². About 30.2 per cent of the population lives below the national poverty level; only 16 per cent has access to electricity; and 75 per cent depends on subsistence agriculture which is mostly rain-fed. About 45 per cent of the land in Rwanda is arable, an estimated 22 per cent is forested, while 18 per cent is pastureland. The significant economic growth, averaging 7.1 per cent per year in recent years, was largely driven by agriculture, which contributed an average of 32 per cent of GDP. Rwanda is taking its future development seriously in view of a rapidly growing population, which is projected to grow to 26 million by 2050, as well as plan. for the impacts of climate change on land, water, food and energy resources. Rwanda's National Climate and Environment Fund, locally referred to as FONERWA, is ground breaking and envisaged to become the engine for the country's green growth over the next 50 years. Its strategy is to provide technical and financial support to public and private projects that align with Rwanda's commitment to a strong green economy.

FONERWA is an instrument for facilitating direct access to international environment and climate change finance, as well as for streamlining and rationalizing external aid and domestic finance. Access to the fund is open to line ministries and districts, research institutions, non-profit organizations and private entities. Currently, FONERWA has about USD 65 million (RWF 50 billion) in funds and has so far invested over USD 28 million

(RWF 22 billion) in projects related to climate change and environmental conservation. Projects are distributed all over the country, particularly in the west and mountainous parts of Rwanda.

The Government of Rwanda is striving to find new sources of energy to replace fuelwood that is being used by a large percentage of the Rwandan population and to increase the proportion of the population with access to electricity. Solar energy is being promoted as an alternative source of energy. A USD 23.7 million solar power plant, located in Rubona, Rwamagana District (Eastern Province), was inaugurated in 2015. The plant is the first utility-scale solar power plant to be built in East Africa and will produce 8.5 megawatts, enough to power 15,000 homes. Currently, the solar plant contributes 5 per cent of Rwanda's current total energy generation capacity of 155 MW. The objective is to increase the country's total generation capacity to 563 MW by 2017/18.

The Green Growth and Climate Resilience National Strategy highlights that, in order to maintain Rwanda's protected areas as key economic assets supporting a climate-resilient services industry, as well as a haven for biodiversity and a source of key ecosystem services, effective protection and sustainable management measures need to be put in place. It is under this framework that the Rwanda Environmental Management Authority and Rwanda Development Board are implementing a project funded by the Global Environment Facility through the World Bank. The Landscape Approach to Forest Restoration and Conservation project will provide a model for landscape management for enhanced environmental services and climate resilience. The project will be implemented in the newly-established Gishwati-Mukura National Park, which contains two degraded mountain natural forests located in the western part of Rwanda. Landscape Approach to Forest Restoration and Conservation aims to restore the landscape by improving the management of the Gishwati and Mukura forests and enhancing local livelihoods and climate resilience within the area.

It is clear that Rwanda, as a low income and densely populated country, faces many challenges in achieving green growth and full climate change resilience. However, notable steps have been taken, ranging from policy responses to the implementation of good practices on the ground. For a significant impact, more good practices should be promoted, such as investing more in watershed management to sustain agriculture in mountainous areas. In addition, given the rapid population growth and the high demand for agricultural land, agroecosystem practices should be adopted to simultaneously improve food security and enhance environmental conservation" (ECA et al. 2016: 21;.41-42).

Reading organiser

Mitigation strategies involve attempts to stabilise and reduce the human production of greenhouse gases. Mitigation strategies may include the establishment of carbon taxes, international climate change agreements, carbon markets and trading schemes, carbon offsetting programmes and the development of low-carbon technologies.

Adaptation involves individuals, communities and states working to try to ensure that people are able to cope with the effects of climate change. Adaptation policies include flood

protection, changes in agricultural production techniques, freshwater conservation, the construction of sea defences, responses to extreme weather events and the treatment of climate sensitive health issues. Although various international efforts to address climate change have been adopted, the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) is widely regarded as the most important instrument in adapting to climate change. "The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change…The Paris Agreement entered into force on 4 November 2016, thirty days after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depositary" (UNFCCC 2017).

Learning unit activity

- Distinguish between mitigation and adaptation strategies.
- Describe the role of the Paris Agreement in international climate change adaptation.
- Discuss the measures taken by Rwanda to address climate change.

Reflection activity

- On the 1st of June 2017, the US announced its intentions to withdraw from the Paris Agreement. In your opinion, will it be more difficult to achieve the goals of the Paris Agreement without the participation of the US (a country which emits large amounts of greenhouse gases annually)?

3.8 FUGITIVE EMISSIONS AND LOUISIANA'S CANCER ALLEY

Reading activity

Study the section "Corridors of uncertainty: 'Fugitive emissions' and the case of Louisiana's cancer alley" on pages 60-63 in Whitehead (2014).

Reading organiser

Scientists have struggled to assess and monitor the air pollution in Diamond, Louisiana. The large scale of air pollution in the region means that it is impossible for scientists and regulators to monitor all air pollution events. The work of scientists is also hindered by the activities of corporations who use the cover of mist, fog and darkness to hide their air polluting activities. While corporations are expected to keep their own inventories of toxic air pollution releases, the leaks and associated forms of fugitive air pollution tend to go unrecorded and unmonitored. Estimates suggest that in Diamond some 80 million pounds of VOC emissions go unreported due to leaks every year.

Learning unit activity

- According to Whitehead (2014:63) "…while science can provide a sure basis for regulating and penalizing polluters…, its requirement for definitive evidence can also be a roadblock to protecting communities and broader ecosystems from long-term harm". Debate whether you agree with this statement with specific reference to Diamond in Louisiana.

Reflection activity

- Whitehead (2014) claims that large corporations and industries release pollutants into the air at night to conceal the actual amount of air pollution they release annually. Do you think this claim is valid? Do you know of areas where large corporations or industries might release pollutants at night?

3.9 KEYSTONE ACTIVITY

Write an essay in which you explore the ways in which human activities have affected the atmosphere as well as the role of science in the understanding of the human-atmosphere relationship in the Anthropocene epoch.

3.10 CONCLUSION

In this learning unit we have explored some of the ways in which human activities have affected the atmosphere in the Anthropocene epoch. Although two inventions of one scientist – Thomas Midgley – had severe effects on the atmosphere, it is very important to recognise the efforts made by scientists to mitigate the effects of human activities on the atmosphere. One prominent example of this is the role of science in addressing climate change. Various stakeholders agree that climate change will have significant effects on Africa. Significant mitigation and adaptation strategies have been adopted to address climate change – as illustrated by the actions taken by the government of Rwanda. Mitigation strategies such as adopting low carbon lifestyles will be addressed in more detail in Learning Unit 8.

References:

Cook, J. 2017. *The 97% consensus on global warming*. Available from: https://www.skepticalscience.com/global-warming-scientific-consensus.htm. [Accessed on: 7 June 2016].

Cook, P.J. 2012. *Clean Energy, Climate and Carbon.* Australia: CSIRO Publishing.

Lewandowsky, S., Oreskes, N., Risbey, J.S., Newell, B.R. and Smithson, M. 2015. Seepage: Climate change denial and its effect on the scientific community. *Global Environmental Change 33*, 1-13.

Milman, O. 2016. Donald Trump picks climate change sceptic Scott Pruitt to lead EPA. Available from: https://www.theguardian.com/us-news/2016/dec/07/trump-scott-pruitt-environmental-protection-agency. [Accessed on: 30 May 2017].

Park, C. and M. Allaby. 2017. *A Dictionary of Environment and Conservation. Third edition.* Oxford: Oxford University Press.

Safi, M. 2016. *Indian government declares Delhi air pollution an emergency*. Available from: https://www.theguardian.com/world/2016/nov/06/delhi-air-pollution-closes-schools-for-three-days. [Accessed on: 31 May 2017].

Tenenbaum, L., Jackson, R. and Shaftel, H. 2017. *Carbon Dioxide*. Available from: https://climate.nasa.gov/vital-signs/carbon-dioxide/. [Accessed on: 31 May 2017].

UNEP (United Nations Environmental Programme). 2016. *GEO-6 Regional Assessment for Africa*. Nairobi, Kenya: United Nations Environment Programme.

UNFCCC (United Nations Framework Convention on Climate Change). 2017. *The Paris Agreement.* Available from: http://unfccc.int/paris_agreement/items/9485.php. [Accessed on: 31 May 2017].

Vidal, J. 2016. *Air pollution more deadly in Africa than malnutrition or dirty water, study warns*. Available from: https://www.theguardian.com/global-development/2016/oct/20/air-pollution-deadlier-africa-than-dirty-water-or-malnutrition-oecd. [Accessed on: 31 May 2017].

4 LEARNING UNIT 4: SOIL DEGRADATION

Sources to consult:

- **Atlas:** Nepal, China, UK (United Kingdom), US (United States) and Canada
- **Map 4:** Land degradation in Africa
- **Prescribed book:** Chapter 4, "Soil: The political ecology of soil degradation", on pages 65-80 in Whitehead (2014)
- **Case Studies:** 4.1 and 4.2
- **Additional Resources on myUnisa:** YouTube video, Podcast and PowerPoint

4.1 INTRODUCTION

According to Mayhew (2015), soil is "the naturally occurring, unconsolidated, upper layer of the ground, made of humus and weathered rock. Major factors affecting soil formation are: climate, relief, parent material, vegetation, and time... Soil is the medium on which we produce 99% of our food; a major store of carbon; and regulator of climate, holding two to three times more carbon than exists in the atmosphere ... Soils are also a regulator of water resources, attenuating hydrological responses and removing contaminants from percolating water".

In the Anthropocene epoch, population growth along with agricultural activities have had a significant impact on the soil resources on the planet. This learning unit will focus on the relationship between population growth and the main forms of soil degradation, namely soil erosion and soil pollution. A number of soil protection techniques will also be discussed towards the end of the learning unit.

4.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to:

- discuss the relationship between population growth and soil degradation
- identify the causes, extent and consequences of soil pollution
- assess the possible impacts of human activities on soil resources and their consequences
- formulate appropriate strategies to reduce or prevent soil degradation

4.3 GETTING UNDER THE PLANET'S SKIN

Reading activity

Study the section "Introduction: Getting under the planet's skin" on pages 65-66 in Whitehead (2014).

Reading organiser

The flat relief and fertile soils of the Great Plains of North America (also known as Prairie in Canada) are very beneficial to a range of agricultural activities. During the 1930s a vast dust bowl developed in the southern section of the plains. In the pursuit of the great profits that could be made from wheat cultivation, farmers engaged in ploughing up vast swathes of the natural grasslands found in the Prairies. The so-called "Great Plow Up" left the soils of the southern Great Plains exposed to soil erosion. Soil erosion made it very difficult to produce

agricultural crops, leading to poverty and famine. Big dust storms started blocking out sunlight and resulted in the migration of people away from the plains.

Learning unit activity

- Describe the events that led to the creation of the Dust Bowl in North America.
- "…Donald Worster (1979) claims the Dust Bowl was one of the most devastating human-induced ecological disasters in history" (Whitehead 2014:65). Evaluate this statement.
- Study Figure 4.1 on page 67 and identify four Canadian cities that are part of the Great Plains of North America.

4.4 SOIL AND ENVIRONMENTAL TRANSFORMATIONS

Reading activity

Study the section "Soil and environmental transformations" on pages 66-73 in Whitehead (2014).

Reading organiser

During the Neolithic Revolution humans gradually moved away from a nomadic society that was based on hunting and gathering food and resources to an agricultural type of society. Agricultural techniques enabled humans to settle in specific regions. This resulted in population growth and an increased demand for food and thereby an increased demand for soil. The increasing demand for soil led to deforestation and the application of inorganic fertilizers after the Industrial Revolution. Between the 1950s and early years of the 2000s, it is claimed that inorganic fertilizer use rose 20-fold, with approximately 100 billion kilograms of nitrogen fertilizers being added to soils every year. The use of inorganic fertilizers has been associated with the rapid increase of crop yields and global food supply. The Haber-Bosch process enabled the production of ammonia from hydrogen and nitrogen. Various compounds of ammonia could then be added to soils in order to improve their fertility.

Soil degradation involves a loss of organic matter, nutrients and water from land mostly due to overgrazing of pastures and overcultivation. Soil degradation leads to biodiversity loss, climate change and the onset of human poverty.

Soil pollution occurs through the addition of toxic chemicals (such as lead, mercury and cyanide) or organic pesticides (such as DDT) to soil. Rachel Carson documented how dichlorodiphenyltrichloroethane (DDT) was rapidly absorbed through soils into plants and animals. Carson's work would ultimately lead to tighter regulations on the use of pesticides throughout the world.

Learning unit activity

- Discuss the relationship between population growth and soil degradation associated with agriculture.
- Explain the role of the Haber-Bosch process in food production.
- Identify the causes, extent and consequences of soil pollution.
- Briefly discuss the role of Rachel Carson in recognising the scale of environmental changes.

Reflection activity

- "Despite concerns regarding the health effects of exposure to DDT (dichlorodiphenyltrichloroethane), it continues to be used for vector control in some developing countries. In 2001, more than 100 nations signed the Stockholm Convention on Persistent Organic Pollutants, aiming to significantly reduce or completely eliminate the use of 12 persistent organic pollutants, including DDT. The Stockholm Convention included a provision for DDT use in malaria control and, as such, it continues to be used in some malaria-endemic countries, including South Africa…" (Whitworth et al. 2014:545). In your opinion, would South Africa experience a *Silent Spring* similar to the one documented by Rachel Carson in 1962? Do you think the number of people affected by malaria in South Africa justifies the use of DDT?

4.5 INTERPRETING THE TRANSFORMATION OF SOIL: A POLITICAL ECOLOGY PERSPECTIVE

Reading activity

Study the section "Interpreting the transformation of soil: A political ecology perspective" on pages 73-76 in Whitehead (2014).

Reading organiser

Before the emergence of political ecology, soil erosion was predominantly understood in three broad ways. First, soil erosion was interpreted as a natural phenomenon that – even when exacerbated by human activity – was largely driven by physical processes (drought and exposure to winds). Second, from a Malthusian perspective, soil erosion was associated with the pressures of overpopulation that forced farmers and landholders to overwork their land in order to feed the growing population. Third, soil erosion was seen as the product of bad decision-making on the part of farmers and landholders. Thus, soil degradation was interpreted as the outcome of farmers either being unaware of sustainable agricultural practices or deliberately overexploiting soil in the pursuit of profit.

The political ecology perspective developed by Blaikie and his colleagues challenged each of the established understandings of soil degradation. Blaikie recognised that drought conditions did not always result in soil erosion. In societies that are more affluent, droughts are routinely endured without significant forms of soil erosion. In terms of Malthusian arguments, political ecologists claimed that advances in agriculture had over time enabled farmers to produce more food from the land without the degradation of soil. In addition, Blaikie's work in Nepal and Africa exposed a strong link between poverty and land degradation. It appeared that the poorest farmers often only had access to the lowest quality soils.

Learning unit activity

- Assess the impacts of human activities on soil resources from a political ecology perspective.

Reflection activity

- "In many ways, Blaikie was a pioneer of the types of analyses that mix human and physical geography, and enable us to better understand the nature of the changes we are experiencing within the Anthropocene" (Whitehead 2014:74). In your opinion,

does a political ecology perspective offer a better understanding of environmental issues?

4.6 SOIL DEGRADATION AND RESTORATION IN CHINA

Reading activity

Study the sections “A Dust Bowl of the twenty-first century: Soil degradation in China” and “Conclusion” on pages 76-80 in Whitehead (2014).

Reading organiser

Soil erosion is now affecting 17 per cent of China’s total land cover. The eroded 4.5 billion tons of additional soil sediments are clogging up the country’s 80 000 reservoirs, reducing water storage capacity and increasing the threat of water scarcity.

China’s expanding economy and population growth have placed pressure on the country’s agricultural sector. These pressures have contributed to the overuse and mismanagement of soil resources. In addition, a significant part of China consists of sloping land. On sloping land, gravity accelerates soil erosion rates. The greater the angle of slope of land, the more severe soil erosion processes are. China’s state-run farms were formed from the properties of wealthy landowners following the communist revolution in China. These farmers were tasked with increasing food production. Outside the state farm system, peasant farmers worked within communal farms. These communal farms were designed to help peasant farmers escape poverty and the yoke of unjust landowners. However, many of these communal farms are located on marginal, sloping land. Moreover, the Chinese government also sanctioned large-scale deforestation to increase timber exports. This enabled the freeing up of more land for agricultural food production. Deforestation increased the exposure of vulnerable soils to erosion and nutrient loss.

The Loess Plateau is located in northwest China and is characterised by large deposits of fine-grained wind-blown soil (loess). Over time, sloped land, fine-grained soil and unsustainable agricultural practices generated a desert-like landscape that was unable to support the 50 million people who lived on the Plateau. During the 1990s, the first Loess Plateau Project saw $252 million invested in the region. The Loess Plateau Project has transformed the landscape of the Plateau into a complex network of terraces. These terraces slow the rates at which soil and nutrients are removed from the land, increase agricultural outputs, and facilitate the regeneration of the landscape when trees, grass and shrubs are planted.

Learning unit activity

- Describe the causes and extent of soil erosion in China.
- Discuss soil restoration techniques in the Loess Plateau.
- Describe the four basic ways in which human activities have affected soil resources.

4.7 SOIL DEGRADATION AND RESTORATION IN AFRICA

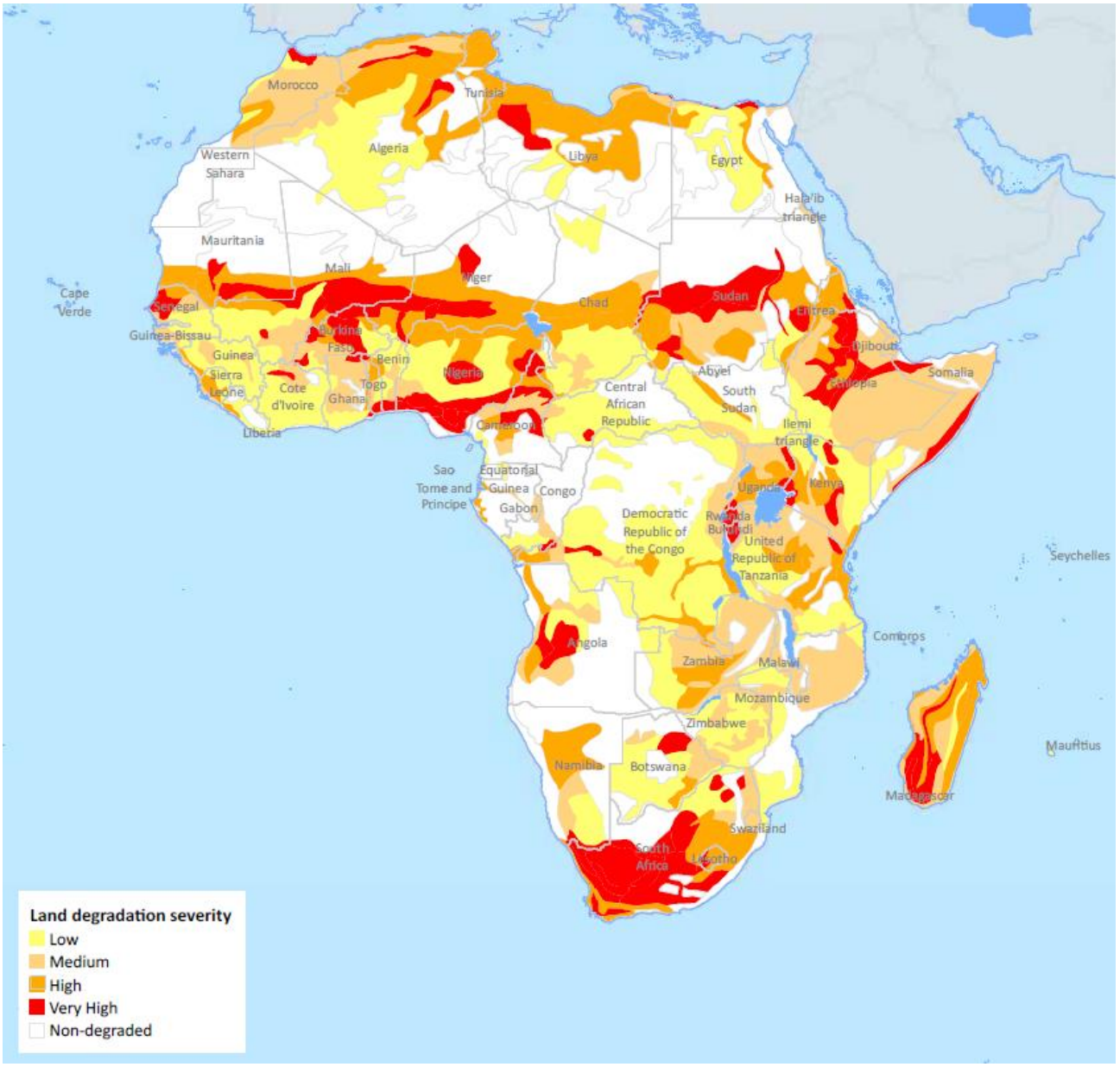
Reading activity

Read Case Study 4.1: Soil degradation in Africa and Case Study 4.2: Soil restoration in Africa.

Case Study 4.1

Soil degradation in Africa

"About 500 000 square kilometres of land in Africa is estimated to be degraded due to soil erosion, salinization, pollution and desertification" (UNEP 2016:41). Map 4 shows the scale of land degradation in Africa. This map is reproduced with permission from UNEP (2016:42).



"Deforestation, forest fires, over-cultivation, inefficient irrigation practices, overgrazing, overexploitation of resources and uncontrolled mining activities, as well as climate change and variability are blamed for the degradation. The impacts of land degradation include reduced agricultural productivity, with concomitant effects on food availability, nutrition and human health. This fuels social, economic and political tensions that can lead to migration.

Between 1960 and 1980, almost 10 million people in the sub-Sahara African region had to move because of drought. Studies from a number of African countries, including Burkina Faso, Egypt, Mali, Morocco and Niger, indicate that land degradation and desertification contribute to human mobility, and to worsening living conditions for both those who leave and those who remain.

Cultivation in much of Africa encroaches on environmentally fragile areas such as steep slopes, riverbanks, shallow soils and wetlands, often without appropriate conservation measures in place, leading to increased soil erosion. Due to small landholdings, farmers are forced to use their land continuously with no rotation, resulting in declining crop yields and the loosening and washing away of soil exposed to natural forces such as wind and water. The offsite impacts of soil erosion include sedimentation of water bodies and loss of breeding grounds for fish, and destruction of infrastructure such as roads and bridges, among others.

Land degradation in drylands can result in desertification. The desert lands of the Sahara, Namib and Kalahari, as well as the drylands of northern Kenya, southern Ethiopia and most of Somalia, cover around 40 per cent of the land surface of Africa. Coupled with climate change, increasing numbers of cattle and other livestock accelerate desertification. In some parts of Africa, such as in Botswana and Namibia, there has been an ongoing trend in livestock numbers exceeding the carrying capacity of the land..." (UNEP 2016: 41-43).

Case Study 4.2

Soil restoration in Africa

"A review of the history of natural resource governance in the mountainous areas of East Africa and the plateau lands reveals that there has been a general marginalization of traditional natural resource management systems, which have evolved through centuries of human-environment interactions, knowledge and experience. These important traditional approaches and practices were abandoned in favour of modern approaches, instead of integrating the two to provide more appropriate and sustainable management systems. Examples of such systems are found in the Kigezi, Mount Rwenzori and Elgon regions in Uganda and on the slopes of Mount Kilimanjaro in Tanzania where traditional agroforestry systems – the traditional blend of crops and trees of different species – have been used throughout the different ecological areas.

The national forest policies in East Africa have been revised to incorporate the promotion of agroforestry practices and to integrate them with modern approaches as a strategy to protect existing natural reserves and improve livelihoods. The *kihamba* agroforestry system, practised on 120,000 hectares on the southern slopes of Mount Kilimanjaro in

Tanzania, is an example of best practice. It is considered to be one of the most sustainable forms of upland farming and provides livelihoods for an estimated one million people. The *kihamba* agroforestry system maximizes the use of limited land. Based on a multi-layered vegetation structure similar to that of a tropical mountain forest, the system provides a large variety of food and substantial environmental services beyond the area where it is practised. With the large quantities of biomass it produces and its capacity to recycle organic matter on farms, the *kihamba* system also contributes significantly to carbon sequestration.

Mountain farming communities have evolved over centuries and have practised a range of soil conservation technologies to safeguard their soil resources. These have improved over time, especially through the integration of modern technologies and government extension services. This wealth of knowledge and experience will play a key role in enabling communities to be resilient and to adapt to the impacts of climate change in this naturally fragile environment. Examples of soil conservation technologies include *Konso* terracing practised in Ethiopia; *fanya juu* terracing in Machakos, Kenya; and contour terracing in Tigray in the Ethiopian Highlands and the Kigezi region in south-western Uganda.

In the Kigezi region, for example, farmers have hundreds of years of experience of bunding and terracing systems which enable them to cultivate steep slopes and utilize marginal land without substantially degrading it. Today, the whole highland region is patterned by a myriad of impressive contour bunds and raised terraces, a practice that has protected the area against soil erosion". The photograph below depicts the *Konso* terracing soil conservation method in Ethiopia.

Figure 4.1: Konso terracing in Ethiopia (Source: EAC et al. 2016:69)

"Bench terracing is a well-known soil conservation practice and is one of the oldest practises in Africa. It is practised throughout the Ethiopia highlands. Experience shows that bench terracing provides a multipurpose structure for enhancing agriculture on steep slopes by controlling soil and water loss. It also creates new cultivable land suitable for irrigation by diversion of perennial rivers, spate irrigation and earthen dam farming (Hagos, 2014).

Bunding and terracing, common in most other mountainous communities, have been adapted and modelled for different local conditions. Examples include the *fanya juu* terracing system used in the Kenya Highlands, which is now being up-scaled in other areas such as Mount Elgon. These practices offer a viable option for conserving mountain soil resources and developing community resilience and adaptation to climate change.

Mountainous areas the world over are under heavy population pressure, both from upland and lowland communities. This has resulted in the widespread clearance of vegetation cover and subsequent land degradation. The African highlands are an example of areas of large-scale deforestation, although efforts have been made to restore the forest cover on many mountain slopes. The desire to restore on-site productivity for the benefit of local communities and the recognition that restored forests provide downstream benefits – improved stream flow and reduced sedimentation – have resulted in some semblance of forest restoration. In areas such as the Kigezi region of Uganda, reforestation has been widely adopted as a means of providing a source of income from the sale of forest products. This has largely been driven by local communities, with little government intervention, which makes the practice more sustainable. Phase II of the WWF Rwenzori Mountains Conservation and Environmental Management Project (2010-2012) provides an example of best practice for the restoration of degraded landscapes. The impacts of the project included capacity building for integrated ecosystem management, community restoration of degraded ecosystems, and improved and sustainable livelihoods for mountain communities. Furthermore, the role that the millions of individuals and households play in landscape restoration – planting tree seedlings on their degraded and marginal lands – should not be underestimated. These initiatives often escape attention, as opposed to the large-scale initiatives by governments and other institutions. The benefits to local communities derived from restoration are undeniable: an increase in the availability of forest products and improved on-site productivity, as well as improvements in general ecosystem productivity and services.

In many areas, communities have abandoned their land due to severe degradation, but after many years these lands have been able to recover. Consequently, many communities are beginning to adopt initiatives to restore degraded land. It is important for the government and other institutions to identify and collaborate with such communities to achieve a faster rate of a landscape recovery and restoration, especially in mountainous areas. The Humbo community in south-western Ethiopia, for example, obtains restored degraded grazing areas and farmlands by setting aside land for natural regeneration. The community is part of the Natural Regeneration Project, registered with the Clean Development Mechanism, which supports forest regeneration by using a variety of tree species through the Farmer-Managed Natural Forest Regeneration technique. As a result, more than 90 per cent of the area devoted to the Humbo community has been reforested. The initiative has resulted in the recovery of 2,728 ha of land" (EAC et al. 2016: 68-71).

GRID-Arendal. 2016. *Sustainable Mountain Development in East Africa in a Changing Climate.* Nairobi, Kenya: UNEP.

Learning unit activity

- Describe the severity of land degradation in South Africa and Madagascar according to Map 4.
- Explain the causes and consequences of soil degradation in Africa.
- Summarise the strategies that have been adopted to reduce or prevent soil degradation in Africa.

Reflection activity

- Study the severity of land degradation in South Africa, Namibia, Botswana and Madagascar in Case Study 4.1 and on Map 4. Do you think the land degradation in these four countries is a consequence of natural processes, overpopulation, or poor farming methods? Motivate your answer.

4.8 KEYSTONE ACTIVITY

Write an essay in which you explore the ways in which human activities have affected soil resources during the Anthropocene epoch. In your answer, refer specifically to soil degradation in China and Africa.

4.9 CONCLUSION

Whitehead (2014:66) argues that one should consider "soil as a form of living skin…As a living skin, soil provides a collective home for water, nutrients and organic matter. It also provides a key link in both the carbon and nitrogen cycle, as these two vital elements circulate around the Earth's ecosystems". Throughout this learning unit we have seen how human activities have affected the planet's soil resources and the consequences of these activities. UNEP (2016: 41) reported that "about 500 000 square kilometres of land in Africa is estimated to be degraded due to soil erosion, salinization, pollution and desertification". Despite the significant extent of soil and land degradation in developing regions such as Africa, various remedial measures have been established to protect soil resources. It is, however, important to take note of the scale of the human alteration of the lithosphere. This is particularly evident from the alteration of the global nitrogen cycle, signalling another proxy for the Anthropocene epoch.

References:

EAC (East African Community), UNEP (United Nations Environment Programme) and GRID-Arendal. 2016. *Sustainable Mountain Development in East Africa in a Changing Climate.* Nairobi, Kenya: UNEP.

Mayhew, S. 2015. *A Dictionary of Geography. Fifth Edition*. Oxford: Oxford University Press.

UNEP (United Nations Environment Programme). 2016. *GEO-6 Regional Assessment for Africa*. Nairobi, Kenya: UNEP.

Whitworth, K.W., Bornman, R.M.S., Archer, J.I., Kudumu, M.O., Travlos, G.S., Wilson, R.E. and Longnecker, M.P. 2014. *Predictors of Plasma DDT and DDE Concentrations among Women Exposed to Indoor Residual Spraying for Malaria Control in the South African Study of Women and Babies (SOWB)*. Environmental Health Perspectives 122, 545-553.

5 LEARNING UNIT 5: BIODIVERSITY LOSS

Sources to consult:

- **Atlas:** Cambodia; Russia; UK; China; Austria; South East Asia
- **Map 5:** Trade routes of ivory
- **Prescribed book:** Chapter 5, "Jungle capitalism and the corporate environment", on pages 81-98 in Whitehead (2014)
- **Case Studies 5.1 and 5.2:** Elephants in the dust: The African Elephant Crisis and Biodiversity hotspots
- **Additional Resources on myUnisa:** YouTube video, Podcast and PowerPoint

5.1 INTRODUCTION

"We live amid a global wave of anthropogenically driven biodiversity loss: species and population extirpations and, critically, declines in local species abundance. Particularly, human impacts on animal biodiversity are an under-recognized form of global environmental change. Among terrestrial vertebrates, 322 species have become extinct since 1500, and populations of the remaining species show 25% average decline in abundance. Invertebrate patterns are equally dire: 67% of monitored populations show 45% mean abundance decline. This recent pulse of animal loss…referred to as the Anthropocene defaunation, is not only a conspicuous consequence of human impacts on the planet but also a primary driver of global environmental change in its own right. Of a conservatively estimated 5 million to 9 million animal species on the planet, we are likely losing ~11,000 to 58,000 species annually" (Dirzo et al. 2014:401). Furthermore, Whitehead estimates that 4 million hectares of African forests are lost every year (Whitehead 2014:83).

In this learning unit we consider deforestation and its links to the start of the Anthropocene Epoch as well as the role of globalisation in biodiversity loss and the illegal exploitation of resources. Specific attention is also given to the illegal ivory trade and its associated decline in African elephant populations.

5.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to:

- discuss how biodiversity loss on a local scale can have regional and global consequences
- describe the role of globalisation in biodiversity loss
- explore possible causes and consequences of the illegal exploitation of resources
- explain how remedial actions can reduce or prevent biodiversity loss

5.3 TRANSFORMING FORESTS: REFLECTIONS ON THE LONG ANTHROPOCENE

Reading activity

Study the section “Transforming forests: Reflections on the long Anthropocene” on pages 82-84 in Whitehead (2014).

Reading organiser

The human clearance of forests may represent an important historical marker in the history of the Anthropocene. According to Ruddiman’s long Anthropocene hypothesis, the reason that the current inter-glacial period has seen a long-term trend in rising levels of greenhouse gases can only be attributed to the rise of agricultural society. The large-scale forest clearances associated with the emergence of agriculture have resulted in a significant reduction in the Earth’s natural capacity to absorb and store carbon dioxide. In addition to this, Ruddiman connects the emergence of rice cultivation some 5 000 years ago with rapid increases in global levels of methane.

The current rate of deforestation, especially in the tropical rainforest biome, is accelerating. Key drivers of deforestation are logging, high demand for timber supplies, agricultural practices such as ranching and palm oil plantations. Tropical rainforests absorb over 1 billion tons of carbon from the atmosphere on an annual basis. Deforestation contributes to the release of around one fifth of humanly produced carbon dioxide, thereby disturbing the local, regional and global climate.

The monitoring of the trade patterns of medium-density fireboard (MDF) in the UK and China has revealed that a growing consumer market for wood products (mostly for household furniture and shelving) is associated with an increase in deforestation rates.

Learning unit activity

- Outline the causes of deforestation.
- Describe Ruddiman’s hypothesis of the “early” or “long Anthropocene”.
- Discuss how tropical deforestation affects the global climate.
- Study Figures 5.1 and 5.2 on pages 83 and 85. Explain the correlation between the production of medium-density fireboard (MDF) in China and the amounts of imported MDF to the UK.

5.4 GLOBALISING THE FOREST AND MULTINATIONAL FOREST CORPORATIONS

Reading activity

Study the section “Globalizing the forest and multinational corporations” on pages 85-91 in Whitehead (2014).

Reading organiser

Globalisation is associated with increasing levels of integration and connection between economic activities throughout the world. Globalisation can be seen to increase the field of competition of those making and supplying goods and services to consumers. Moreover, globalisation expands the market place within which successful entrepreneurs can sell their products and services. The flow of investments to successful economic enterprises in

diverse geographical locations is streamlined by globalisation, which makes it easier for enterprises to grow. Joseph Stiglitz contends that while there is potential for globalisation to enhance the lives of people throughout the world, the form it is presently taking is having a detrimental impact on the freedoms and lifestyles of many throughout the world.

Multinational corporations (MNCs) come in a range of forms and sizes, but they have one thing in common. What connects MNCs is their ability to organise their economic activity at an international scale, and to be able to move these activities between a range of different countries. While MNCs are diverse, their significance as agents within the Anthropocene should not be underestimated. Of the one hundred most wealthy global organisations (including nation states), 66 are now corporations. In environmental terms, critics of MNCs argue that the geographical freedoms of MNCs have made it easy for them to exploit locations where environmental standards are lower and expensive anti-pollution measures and waste treatment can be avoided.

Globalisation has now made it much easier for large timber and paper MNCs to exploit the rich timber resources within the tropics. While some 80% of global forests are publically owned, many less economically developed countries are keen to grant logging permits to MNCs as a basis for securing investment and employment opportunities within their countries. The impact of globalisation on forest resources stretches beyond the actions of the international timber industry. In many parts of the world the clearance of tropical woodlands has been driven by agricultural interests who are keen to exploit the agricultural lands that are found beneath the canopies of rainforests. As with multi-national timber operations, these agricultural practices are often coordinated by global food corporations who are eager to exploit tropical climates in order to produce high profit-yielding commodities such as beef and bananas. The extent of current illegal logging activities is clearly the product of the great profits that can be made within the global timber markets. The processes of globalisation also make it much easier to traffic illegal timber throughout the world. As illegal timber is transported throughout the world its association with illegal points of origin can be easily obscured.

The Chainsaw Project is a partnership between INTERPOL and the World Bank that was initiated in 2007. The idea behind the project was to connect environmentally-oriented research on the long-term ecological impacts of illegal logging to discussions of international criminal justice. INTERPOL now estimates that a forested area equivalent to the size of Austria is lost to illegal logging every year. This means that the amount of illegally produced timber represents somewhere between 20 and 50% of the total global timber market.

Learning unit activity

- Summarise the key aspects of globalisation.
- Describe Stiglitz's critique of globalisation.
- Explain why the role of multi-national corporations (MNCs) should not be underestimated in the Anthropocene Epoch.
- According to Whitehead (2014: 90), "External forces and distant decision-makers, who have little sense of the broader biological integrity and social value of woodlands, now determine what goes on in different forests throughout the world." Debate

whether you agree with this statement and provide evidence to support your viewpoint.

- Discuss the link between illegal logging and globalisation according to the Chainsaw Project.
- Study Figure 5.4 on page 91. Compile a list of the countries where less than 50% of the total logging activity is regarded as legal logging.

Reflection activity

- Joseph Stiglitz contends that while there is "potential for globalisation to enhance the lives of people throughout the world, the form it is presently taking is having a detrimental impact on the freedoms and lifestyles of many throughout the world" (Whitehead 2014:87). Do you agree with this statement? Give reasons to support your answer.

5.5 JUNGLE CAPITALISM: THE CASE OF THE UNITED FRUIT COMPANY

Reading activity

Study the section "Jungle capitalism: The case of the United Fruit Company" on pages 92-94 in Whitehead (2014).

Reading organiser

The United Fruit Company (UFC) was officially established on the 30th of March 1899. By this point, however, it already owned land in Costa Rica, Panama, Columbia, Cuba, Jamaica and the Dominican Republic, which collectively constituted some 50 000 acres. Over the course of the twentieth century, UFC would become one of the dominant players in the international fruit trade and almost develop a total monopoly on the production and transportation of bananas. Over time, UFC expanded its corporate interests and started to buy up radio-broadcasting companies, postal services and established sugar and palm oil plantations. During the middle decades of the twentieth century, UFC was one of the largest employers in the whole of Central America and acquired significant political influence in all the countries within which it operated.

The term "banana republic" was coined to describe a weak and possibly corrupt state that becomes the servant of corporate interests (MNCs). This term was coined to describe the impacts that the operations of corporations like UFC were having in places like Central America. Following the Guatemalan election of President Jacobo Árbenz in 1951, the UFC became concerned about the incoming president's proposed land reforms. Guatemala's banana plantations accounted for a quarter of all of UFC landholdings in South America. UFC consequently utilised its connections with the US Central Intelligence Agency (CIA) in order to orchestrate a coup d'état in Guatemala. In 1954 Árbenz was ousted from power and his government replaced with a military junta that was much more sympathetic to the needs of UFC.

UFC was able to use its unchallenged power to acquire large parts of Central America's rainforests. These forests were either cleared to make way for large banana or sugar plantations, or simply left unused. UFC would often take ownership of large tracts of land,

which it had no intention of using in order to prevent its competitors from acquiring productive land. This meant that communities who had previously relied on forests to secure precious food and resources had to move elsewhere. In the UFC plantations emphasis was placed on high levels of agricultural production with little regard for ecological sustainability. The emphasis that UFC placed on high-yielding agricultural output resulted in it concentrating most of its plantation activities on the growing of one particular type of banana: the Gros Michel, or Big Mike. In concentrating its efforts on the growth of the Big Mike, UFC created a monoculture plantation system throughout Central America. Subsequently, Panama disease swept through UFC plantations and decimated its banana harvest. Given its unchallenged power in Central America, and its access to large swathes of forested land, UFC's solution to the problem was to move its activities around. UFC's response when the disease had taken hold was to move on to new land, to a new country if needed, and to carve out another part of Central America's "infinite" jungle.

The example of UFC also indicates how, in the age of globalisation, the fate of forests becomes dislocated from the places in which they are located, and is instead connected to economic decisions that are made in distant corporate boardrooms.

Learning unit activity

- Explain how the United Fruit Company (UFC) expanded its influence in Central America.
- Study Figure 5.5. Complete the list of activities of UFC in Central America in 1951 in the table below.

Country	UFC Activities
Cuba	Sugar plantations Radio services
Jamaica	
Dominican Republic	
Columbia	
Panama	
Costa Rica	
Nicaragua	
Honduras	
Guatemala	
Mexico	

- Describe how the term "banana republic" became associated with the activities of UFC.
- Discuss the consequences of UFC's banana, sugar and agricultural activities in Central America.

Reflection activity

- Revisit the Malthusian, Cornocupian and Marxist theories discussed in learning unit 2. In your opinion, which of these theories can best describe UFC's response to the outbreak of Panama disease in their banana plantations?

- In your opinion, which measures or steps can be taken to ensure that local and regional stakeholders have more influence over local resources such as forest products?

5.6 BIG BOX RETAIL AND THE GLOBAL TIMBER SUPPLY CHAIN

Reading activity

Study the section “Big box retail and the global timber supply chain” on pages 94-97 in Whitehead (2014).

Reading organiser

Through the combination of low prices and marketing, big box retailers are clearly contributing to the escalating demands that are placed on the world’s forests to supply timber to the market. It has been observed that manufacturers and timber producers find creative – and sometimes illegal – ways to lower prices for big buyers, for instance lowering employee wages and health-and-safety measures, purchasing more illegal timber, and adopting destructive forest practices. The UK Environmental Investigation Agency found that the baby cribs sold by Walmart were made from wood that was sourced in areas of Russia that had very high rates of illegal logging, which is often carried out during the tiger breeding season. On this basis, the Environmental Investigation Agency concluded that it was likely that Walmart products contained illegally sourced timber whose harvesting was having a detrimental effect on forest ecosystems and biodiversity. While big box retailers may be oblivious to the presence of illegal timber within their products, it is clear that economic practices and associated global supply chains create the incentives and opportunities that lead to the exploitation of forests. Following media coverage of such controversial sourcing practices, many retailers are trying to take greater responsibility for precisely where their wood is coming from. In order to support such corporate greening activities, there are now official forest certification processes. These initiatives are often led by environmental non-governmental organisations (NGOs) such as the Forest Stewardship Council, and provide an official labelling system for timber products that have been produced in socially and environmentally just ways.

Learning unit activity

- Describe the environmental consequences of big box retail.
- Briefly discuss the measures taken to address accountability of MNCs in the timber supply chain.

Reflection activity

- In your opinion, does corporate environmental responsibility initiatives such as forest certification translate into ethical use of forest products?
- Compile a list of forest products you use on a frequent basis. These may include pencils, paper and home and office furniture. Check these products to see if you can determine the country of origin. How many of these products do you think were once part of the illegal logging supply chain?

5.7 ILLEGAL EXPLOITATION OF RESOURCES: A CASE STUDY ON ELEPHANT POPULATIONS

Reading activity

Read Case Study 5.1.

Case Study 5.1

Elephants in the dust: The African Elephant Crisis

A pronounced upward trend in both the poaching of African elephants and the illicit trade in ivory is particularly evident from 2007 onwards. Illicit ivory trade activity and the weight of ivory behind this trade has more than doubled since 2007, and is over three times greater than it was in 1998. Viewing all of these data together and considering a range of other information, it is clear that African elephants are facing the most serious conservation crisis since the species was moved from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II to Appendix I in 1989, and a ban on commercial trade in ivory and other elephant specimens came into effect (the African elephant populations of Botswana, Namibia, South Africa and Zimbabwe subsequently returned to Appendix II, allowing them to trade certain elephant specimens under strict conditions, including on two occasions – in 1999 and 2008 – stocks of raw ivory). Current population estimates suggest alarming declines in elephant numbers in parts of Central and West Africa, as well as an increasing risk of the local extinction of some populations. Previously secure populations in Eastern and Southern Africa are under growing threat, as a wave of poaching seems to be spreading east and southwards across the African continent. Currently, it is likely that the total continental population estimate is in the range of 420,000 to 650,000 African elephants, with just three countries, Botswana, Tanzania and Zimbabwe accounting for well over half of these elephants. However, these numbers could change rapidly if present trends continue. In 2011, poaching levels were at their highest since Monitoring the Illegal Killing of Elephants (MIKE) began monitoring the trends in illegal killing in 2001, and indications suggest that the situation did not improve in 2012. Similarly, the seizure of large shipments of ivory hit an all-time high in 2011, indicating an increasingly active, profitable and well-organized illegal ivory trade between Africa and Asia.

Poaching is spreading primarily as a result of a rising demand for illegal ivory in the rapidly growing economies of Asia, particularly China and Thailand, which are the two major end-uses markets globally. The high levels of poaching are, in some cases, facilitated by conflicts that, through lawlessness and ensuing abundance of small arms, provide optimal conditions for illegal killing of elephants. This situation is further exacerbated in many countries due to weak governance and collusive corruption, at all levels. Poverty facilitates the ability of organized criminals to recruit, bribe or threaten locals and underpaid police, military personnel and wildlife rangers.

Elephant population trends in the 20th and 21st century

Much of the elephant population of West Africa had been decimated before the turn of the 20th century.... Most of the data on elephant populations in Central Africa is unreliable and no real data on elephant numbers existed prior to the 1990s. However, it is widely agreed that the forest elephant populations in Central Africa, particularly in the Democratic Republic of Congo, were greatly reduced in the 1970s and 1980s…Eastern Africa, home to the highest number of elephants prior to 1970, was hit hard by the poaching of the 1970s and 1980s... Southern Africa stands out from the other regions. Although poaching also occurred in Southern Africa in the 1970s and 1980s, the numbers were not even close to those of Central and Eastern Africa. In fact, the elephant populations of Southern Africa have, to a much greater extent, been protected through targeted conservation efforts. It is the only region that has shown a definite and clear population increase over recent decades (UNEP et al. 2013: 23-25).

WHAT DRIVES POACHING?

Ultimately, the illegal trade in ivory is driven and sustained by consumers who are willing to pay high prices for the commodity, regardless of its origin or legality. Ivory carvings have been a much revered luxury and status symbol in many parts of the world for centuries. Demand in some traditional markets, which flourished through much of the 20th century, like Europe, North America and, more recently, Japan, have dwindled in the last few decades through awareness campaigns linking ivory to the death of elephants. China's ivory market has followed a very different pattern. Demand for ivory in China lay dormant for much of the 20th century, but has in recent years made a remarkable resurgence, to the extent that China is now the world's largest destination market for illegal ivory.… While the illicit trade is ultimately driven by demand, the easy availability of illegal ivory exacerbates it. Ivory can be found openly on display in markets and shops in many African cities, such as Khartoum, Kinshasa, Lagos, and Luanda, as well as in certain Asian cities. Most of these markets operate with impunity due to lack of law enforcement action, and often in blatant disregard of national legislation prohibiting trade in illegal ivory. Consumer demand for illegal ivory and the prevalence of unregulated or insufficiently supervised markets open up opportunities for profit by transnational criminal networks. The involvement of organized criminals in the illegal ivory trade is evidenced by the increasing trend in seizures of large-scale ivory shipments between Africa and Asia. Moving large quantities of illegal ivory across international borders requires substantial resources, organization and financial means for funding operations and logistics. These transnational networks keep ahead of law enforcement by adapting their tactics and routes to avoid detection, making national borders increasingly irrelevant.

At the national level, poor law enforcement, weak governance structures and political and military conflicts are some of the main drivers that facilitate poaching and allow illicit trade in ivory to grow. Weak governance in source, export and transit countries, significantly contribute to the illegal movement of ivory across national borders, as enforcement officers in such countries are often susceptible to corruption…Weak governance is likely to play an important role at all points of the illegal ivory trade chain, from poaching on the ground to the smuggling and marketing of illegal ivory. Armed conflict in some source countries facilitates poaching and is often also associated with illegal mineral resource extraction. This

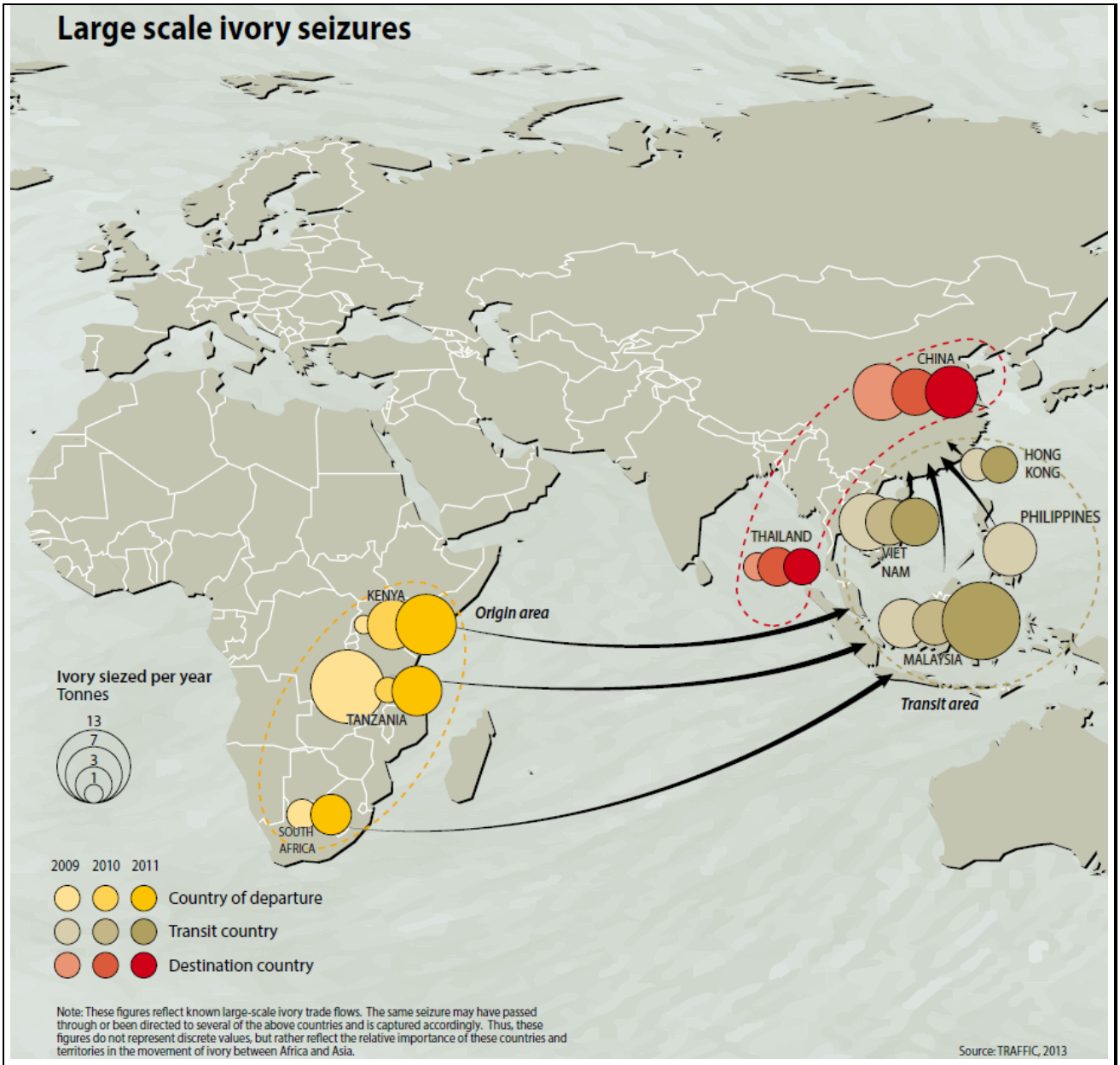
is the case in Central Africa, where elephant populations in areas such as eastern Democratic Republic of Congo and northern Central African Republic have been heavily depleted in parallel with armed conflict. Rebel militia groups, including the Lords Resistance Army in Central Africa and the Janjaweed of Chad and Sudan, are alleged to be implicated in elephant killing raids. The ivory collected is believed to have been exchanged for money, weapons and ammunition to support conflicts in neighboring countries (UNEP et al. 2013:40-41).

Locally, poaching levels are associated with a wide variety of complex socio-economic factors and cultural attitudes. Poaching and hunting for bushmeat, for example, are exacerbated by poverty, and recent studies suggest that the killing of elephants for their meat will grow as other kinds of bushmeat and protein sources become scarcer. The analysis of MIKE data also shows that the level of poverty in and around MIKE sites, as measured by human infant mortality rates and food security, as measured by livestock and crop densities, correlate strongly with the levels of elephant poaching. While hunting for meat or ivory has been a traditional source of protein and income for many rural communities, poverty also facilitates the ability of profit-seeking criminal groups to recruit local hunters who know the terrain, and to corrupt poorly remunerated enforcement authorities (UNEP et al. 2013:41).

African elephants are thought to be a keystone species, because in small numbers, they have lasting impacts. They often are labelled as bioengineers. For example, their destruction or altering of trees positively influences herpetofaunal diversity, as they create more three-dimensional habitat diversity for these herps (Howard 2017). Therefore, the loss of elephants will have significant knock-on effects on ecosystems.

Departure points and destinations

The two countries most heavily implicated as destinations for illicit trade in ivory are China and Thailand. In terms of trade routes and transit countries or territories through which large quantities of ivory are flowing from Africa to Asian consumers, Hong Kong SAR, Malaysia, the Philippines and Vietnam are the paramount countries and territories of concern (UNEP et al. 2013: 46). Map 5.4 shows the trade routes of ivory.



Map 5: Trade routes of ivory (UNEP et al. 2013:47).

Moving to source countries and exit points for large amounts of ivory leaving the African continent, Kenya, Tanzania and South Africa are presently the countries of greatest concern. More ivory is moving through and out of these countries at the present time than any other countries in Africa. All along the trade chains in these countries and territories, organised criminal syndicates are an active force undermining international and national regulations that prevent trade in ivory. In sum, these nine countries and territories are the players most heavily implicated in the illegal trade in ivory at the present time according to the Elephant Trade Information System (ETIS) data. Another ten countries and territories – Cameroon, Congo, the Democratic Republic of Congo, Egypt, Ethiopia, Gabon, Mozambique, Nigeria, Taiwan and Uganda – represent a secondary level of concern as they repeatedly play important supporting roles in the illicit ivory trade. These players represent a mix of source, entrepôt/transit and exit countries for illicit consignments of ivory from Africa, while Taiwan is a potential transit point for ivory moving through Asia. Egypt, the Democratic Republic of Congo, Mozambique and Nigeria all have important unregulated domestic ivory markets in

their major cities, while Nigeria, Mozambique, Uganda and Cameroon have been implicated in the largescale movement of ivory, which indicates the involvement of organised crime syndicates (UNEP et al. 2013: 46-49).
Map 5.5: Trafficking routes of illegal ivory (UNEP et al. 2013:48)

The African Elephant Action Plan and the African Elephant Fund
Following a decision at CITES COP 14 held in the Hague in 2007, the African Elephant Action Plan was developed by the 38 African Elephant range States. The Action Plan was adopted by all range States in 2010 at COP 15 in Qatar, with the vision to ensure a secure future for African Elephants and their habitat to realize their full potential as a component of land use for the benefit of the human kind.
In adopting the Action Plan, all African range States have recognized that the threats faced by the African elephant must be addressed immediately, otherwise they may result in entire populations being lost. The Action Plan seeks to address "the situation on the ground" and has identified eight priority objectives:

1. Reduce the illegal killing of elephants and the illegal trade in elephant products;
2. Maintain elephant habitats and restore their connectivity;
3. Reduce human-elephant conflict;
4. Increase awareness among key stakeholders about elephant conservation and management;
5. Strengthen range States' knowledge about African elephant management;
6. Strengthen cooperation and understanding among range States;
7. Improve local communities' cooperation and collaboration on elephant conservation; and
8. Effectively implement the African Elephant Action Plan.

In order to achieve these eight objectives, a list of necessary activities has been laid out. Among some of the listed activities proposed by the Action Plan, range States have identified the need to strengthen the capacity of law enforcement authorities and agencies to combat poaching and illegal trade, and to harmonize and strengthen national policies and laws relevant to conservation and management of elephants. Connectivity between elephant ranges within and across range States must also be ensured, and multilateral support for the management of elephant sites and cross-border corridors must be established and improved. Additionally, sustainable incentive schemes that benefit local communities must be implemented and the status of elephant populations within and among range States must be monitored. To implement all activities in the African elephant action plan for a period of three years, an estimated USD 100 million will be required. The activities of the Action Plan are supported by the multi donor African Elephant Fund which was established in 2011. To date, the African Elephant Fund has received some USD 600,000 in contributions from China, France, Germany, the Netherlands, Great Britain and Northern Ireland, and South Africa (UNEP et al. 2013: 52, 53, 71).

International Trade in Endangered Species of Wild Fauna and Flora), IUCN (International Union for Conservation of Nature) and TRAFFIC. 2013. *Elephants in the Dust – The African Elephant Crisis. A Rapid Response Assessment*. Arendal, Norway: UNEP, GRID-Arendal.

Learning unit activity

- Describe the trend in the poaching of African elephants and the illegal trade in ivory since the year 1989. Explain which drivers are responsible for this trend.
- Describe the role of globalisation in the illegal trade of ivory.
- Discuss the consequences of the illegal trade of ivory.
- Study Map 5. Compare the trend in the amount of ivory seized in the countries of departure from 2009 to 2011. Provide possible reasons for the disparity in the amounts of ivory seized in transit countries as opposed to destination countries.
- List the priority objectives of the African Elephant Action Plan.

Reflection activity

- Consider how the term "banana republic" is associated with UFC's activities in Central America. In your opinion, should the following countries be regarded as "ivory republics" due to their involvement in the illegal trafficking of ivory: Cameroon, Congo, the Democratic Republic of Congo (DRC), Egypt, Ethiopia, Gabon, Kenya Mozambique, Nigeria, South Africa, Tanzania and Uganda?

5.8 BIODIVERSITY HOTSPOTS

Reading activity

Read Case Study 5.2.

Case Study 5.2

Biodiversity hotspots

A number of international conventions have been adopted to address biodiversity issues. These conventions are the Convention on Biological Diversity, The International Plant Protection Convention, The Ramsar Convention on Wetlands of International Importance, the Convention on the Conservation of Migratory Species of Wild Fauna and Flora, the World Heritage Convention, the International Treaty on Plant Genetic Resources for Food and Agriculture, and CITES (CBD Secretariat 2017). Although these conventions have provided a structure for regional and local efforts to protect biodiversity, biodiversity hotspots were established to streamline biodiversity conservation efforts.

Marchese (2015:298) defines biodiversity hotspots as "areas with high concentrations of endemic species (species that are found nowhere else on Earth) and with high habitat loss". The aim of identifying biodiversity hotspots is to improve conservation

efforts by concentrating financial aid and legislation to specific geographic areas (Hopper et al. 2015).

"Global biodiversity hotspots were identified originally as the 25 terrestrial regions on Earth richest in endemic species under threat. Subsequent revisions now list 35 terrestrial, and 10 marine biodiversity hotspots. Prior to extensive habitat conversion by humans, the 35 terrestrial hotspots covered 16 % of the Earth's surface. Now, with more than 85% of their habitat destroyed, only 3.4 million km^2, or 2.3% of the Earth's land surface, is occupied by wild biodiversity in these hotspots. Yet an extraordinary 150,000 vascular plant (38% of the global total) and 22,940 vertebrate species (77%) occur on this 2.3% of the Earth's land area, with more than 130,000 endemic plant species" (Hopper et al. 2015:167-168). According to UNEP (2016:73), eight biodiversity hotspots are located on the African continent, hosting an estimated 5 015 endemic species. Table 5.1 below indicates the names and locations of the eight African biodiversity hotspots.

Table 5.1: Biodiversity hotspots in Africa

Name	**Location**
Cape Floristic Region	South Africa
Coastal Forests (Mangroves) of Eastern Africa	Kenya, Mozambique, Somalia and Tanzania
Eastern Afromontane	Burundi, Democratic Republic of Congo, Ethiopia, Eritrea, Kenya, Malawi, Mozambique, Rwanda, Saudi Arabia, Tanzania, Uganda, Yemen and Zimbabwe
Guinean Forest of West Africa	Benin, Côte d'Ivoire, Equatorial Guinea, Ghana, Guinea, Liberia, Nigeria, São Tomé and Príncipe, Sierra Leone and Togo
Horn of Africa	Djibouti, Ethiopia, Eritrea, Kenya, Oman, Somalia and Yemen
Madagascar and Indian Ocean Islands	Comoros, Madagascar, Mauritius and Seychelles
Maputaland–Pondoland–Albany	Mozambique, South Africa and Swaziland
Succulent Karoo	Namibia and South Africa

Even though climate change poses a significant threat to all the biodiversity hotspots in Africa, it is important to mention an example from the arid Succulent Karoo hotspot in Namibia and South Africa. Young et al. (2016) contend that plant species from the genus *Conophytum* – considered to be extremely drought tolerant, may become extinct. Moreover, habitat loss and fragmentation together with invasive alien species, agriculture, urbanisation and fires have endangered a large amount of biodiversity in the Cape Floristic Region (CFR), which have led to the city of Cape Town being declared a biodiversity "mega-disaster" area. It is estimated that the Cape Floristic Region (CFR) is home to 9 000 plant species, of which 70% are endemic (West et al. 2016:184).

The International Union for Conservation of Nature (IUCN) (2015) estimates that approximately 10 million hectares of the Guinean Forest of West Africa were lost prior to the year 2000. In addition to agricultural activities, urbanisation and the construction of roads and establishment of industries were the main drivers contributing to the deforestation in this biodiversity hotspot (IUCN 2015). Arcilla et al. (2015:41;47) points out that "over 80% of Ghana's Upper Guinea forests have been cleared, mainly for agriculture and settlement, and remaining forest is highly fragmented". Furthermore, as the amount of logging activities increased in Ghana "…understory bird communities declined >50% in abundance and did not show any indication of recovery". However, measures have been taken to promote the sustainable use of forest resources. "These include the promotion of forest law enforcement, governance and trade (FLEGT), through bilateral and multilateral initiatives, such as the EU's Voluntary Partnership Agreements (VPAs), which are currently being implemented with Cameroon, Ghana and Liberia and negotiated with Côte d'Ivoire" (IUCN 2015:191). In addition, significant progress has been made in forest certification in Ghana and Cameroon (IUCN 2015).

Marchese (2015) argues that although biodiversity hotpots have attracted financial and institutional support, it can easily become a panacea to addressing biodiversity loss and the conservation of biodiversity. This is due to the exclusion of invertebrates (such as insects and worms) and coldspots (such as coral reefs).

Learning unit activity

- List the international conventions that play a role in biodiversity conservation.
- Identify the biodiversity hotspots in Africa that are located in the northern hemisphere.
- Explain the role of hotspots in biodiversity conservation.
- Describe the significance of climate change on biodiversity in the Succulent Karoo.
- Discuss the causes of biodiversity loss in the Cape Floristic Region (CFR).
- Briefly describe the measures taken to promote the sustainable use of resources in the Guinean Forest of West Africa.

Reflection activity

- Consider the threats to biodiversity in Africa's biodiversity hotspots. In your opinion, would planting indigenous vegetation in gardens and botanical parks assist with the preservation of species such as those from the genus *Conophytum* (endemic to Namibia and South Africa)?

5.9 KEYSTONE ACTIVITY

Whitehead (2014:84) argues that "the human clearance of forests may represent an important historical marker in the history of the Anthropocene". This argument is echoed by Dirzo et al. (2014:401) who contend "the Anthropocene defaunation is not only a conspicuous consequence of human impacts on the planet but also a primary driver of global

environmental change in its own right". Write an essay in which you debate whether you agree with the abovementioned statements.

5.10 CONCLUSION

In this learning unit we have explored the causes and consequences of biodiversity loss in the Anthropocene as well as remedial measures to mitigate or prevent these losses. Furthermore, the role of globalisation and MNCs in facilitating biodiversity loss and illegal exploitation of resources were considered. While the illegal trade in ivory poses a significant threat to one of Africa's most iconic mammals – the African elephant – other species are also facing increasing pressure on their survival. To conclude this learning unit, the paragraph below highlights the status of African lion populations (*Panthera leo*).

"African lions have shrunk to just 8% of their historic range, with only 20,000 left in the wild. About 1,500 a year are hunted as trophies… A rising trade in lion bones to Asia, where such bones are replacing scarce tiger bones in supposed tonics, has raised fears of further declines. South Africa alone legally exported 1,200 skeletons – 11 tonnes of bones – between 2008 and 2011… 182 countries at the Convention on the International Trade in Endangered Species (Cites), meeting in Johannesburg, were unable to agree on a proposal from nine African countries to ban all international trade in lion parts. Instead, a compromise agreement banned only the trade in bones, teeth and claws from wild lions. Those coming from captive-bred lions will still be legally sold, although South Africa will now have to report on how many it sells each year. The export of trophies from lion hunting remains legal" (Carrington 2016).

References

Arcilla, N., Holbech, L.H. and O'Donnell, S. 2015. Severe declines of understory birds follow illegal logging in Upper Guinea forests of Ghana, West Africa. *Biological Conservation 188*, 41-49.

Carrington. 2016. Countries fail to agree on complete ban to protect African lions from global trade. Available from: https://www.theguardian.com/environment/2016/oct/02/african-lions-trade-ban-fails-global-wildlife-summit. [Accessed on: 08 August 2017].

CBD (Convention on Biological Diversity) Secretariat. 2017. *Biodiversity-related Conventions*. Available from: https://www.cbd.int/brc/. [Accessed on: 28 July 2017].

Dirzo, R., Young, H.S., Galetti, M., Ceballos, G., Isaac, N.J.B. and Collen, B. 2014. Defaunation in the Anthropocene. *Science 345*, 401-406.

Hopper, S.D., Silveira, F.A.O. and P.L. Fiedler. 2016. Biodiversity hotspots and Ocbil theory. *Plant Soil 403*, 167–216.3

Howard, M. 2017. *Loxodonta africana*. Available from: http://animaldiversity.org/accounts/Loxodonta_africana/. [Accessed on: 7 August 2017].

IUCN (International Union for Conservation of Nature). 2015. *Ecosystem Profile: Guinean Forests of West Africa Biodiversity Hotspot*. Gland, Switzerland: IUCN.

Marchese, C. 2015. Biodiversity hotspots: A shortcut for a more complicated Concept. *Global Ecology and Conservation 3*, 297-309.

UNEP (United Nations Environmental Programme), CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), IUCN (International Union for Conservation of Nature) and TRAFFIC. 2013. *Elephants in the Dust – The African Elephant Crisis. A Rapid Response Assessment*. Arendal, Norway: UNEP, GRID-Arendal.

West, S., Cairns, R. and Schultz, L. 2016. What constitutes a successful biodiversity corridor? A Q-study in the Cape Floristic Region, South Africa. *Biological Conservation 198*, 183–192.

Young, A.J., Guo, D., Desmet, P.G. and Midgley, G.F. 2016. Biodiversity and climate change: Risks to dwarf succulents in Southern Africa. *Journal of Arid Environments 129*, 16-24.

6 LEARNING UNIT 6: URBANISATION AND THE ENVIRONMENT

Sources to consult:

- **Atlas:** Tigris-Euphrates river plains (Iraq, Kuwait), Manchester, London, Massachusetts, Las Vegas, Hong Kong, Shenzhen, Guangzhou, Lagos, Addis Ababa.
- **Prescribed book:** Chapter 6, "Cities: Sprawl and the urban planet", on pages 99-119 in Whitehead (2014)
- **Case Study 6:** Efficiency of parks in mitigating urban heat island effect: An example from Addis Ababa
- **Additional Resources on myUnisa:** YouTube video, Podcast and PowerPoint

6.1 INTRODUCTION

"…By 2008 not only were some 3.2 billion people living in cities and urban areas, but the rate of expansion associated with the global urban population was accelerating. The United Nations estimates that approximately 50 million people…are added to the population of the planet's cities and suburbs every year" (Whitehead 2014:99). "For the past few decades, Africans have been moving from rural areas into cities, seeking work, so the continent's urban population has skyrocketed. Nairobi is a prime example of that migration, with its population pushing upward and its boundaries pushing outward. Nairobi, like most cities in Africa, is experiencing dramatic growth… While such migration often mirrors economic advancement, it also presents socioeconomic and environmental challenges. Rapid urban growth strains existing infrastructure. Conservationists also note that it discourages the preservation of natural habitat in favour of building more developments. In Nairobi, urbanization has caused the city to encroach on former green spaces like the nearby national parks and forests. At the time of the last official government census in 2009, the population of Kenya numbered more than 38 million people. The city of Nairobi houses 3.5 million of them, which is more than double the 1986 population" (NASA Earth Observatory 2016).

With an ever-growing proportion of the global and African population moving to urban areas, it is important to explore the impacts of urbanisation on the environment. In this learning unit we will examine the different forms of urbanisation, the consequences of urbanisation on the environment, and strategies which are implemented to mitigate environmental degradation.

6.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to:

- identify and distinguish between the different forms of urbanisation
- describe how urbanisation can have regional and global consequences
- discuss the causes and consequences of the Urban Heat Island (UHI) on human life
- formulate appropriate strategies to reduce or prevent environmental degradation associated with urbanisation and the UHI

6.3 A BRIEF HISTORY OF URBANISATION: FROM MESOPOTAMIA TO THE MEGA-REGION

Reading activity

Study the sections “Introduction: Urbanisation and why Darwin was wrong after all” and “A brief history of urbanisation: From Mesopotamia to the Mega-region” on pages 99-105 in Whitehead (2014).

Reading organiser

The United Nations Environment Programme (UNEP) estimates that 80 per cent of all anthropogenic carbon dioxide emissions are a product of “urban-based activities”. Furthermore, the Organisation for Economic Co-operation and Development (OECD) claims that around 50 per cent of total public spending on environmental policies and services in more economically developed countries is spent by local governments. It might be helpful to consider our contemporary geological period not as the Anthropocene so much as the *Metropocene* - a period defined by the dynamics and demands of urbanisation.

If urbanisation reflects the relatively large-scale concentration of people, resources and infrastructures into one place, the first incidence of urban areas dates back to the Neolithic age around 4 000 BCE, when small cities started to emerge in the fertile plains between the Tigris and Euphrates rivers. This area, which is now contained predominately in the modern state of Iraq, was known at the time as Mesopotamia – meaning “land between two rivers”. In 1760, when England was still a predominantly rural-dwelling country, the population of Manchester stood somewhere between 30 000 and 45 000 people. By 1801 this population had risen to 72 000, and by 1851 to 303 382; that is nearly a sevenfold increase in the size of the city in the space of 91 years – mostly due to industrialisation. Unlike its densely packed European counterpart, the American city of the twentieth century was a city that was defined by the spatial expansion of the city. This new urbanisation process was facilitated by the rise of mass transit systems (including both public transport and the motorcar), and led to the creation of a new urban phenomenon: sprawl. Los Angeles and Las Vegas are examples of the new form of urbanisation. While some of these megacities are industrial (the Rheine-Ruhr agglomeration) and suburban (Los Angeles) cities, which have expanded to megacity status over a relatively long time period, many megacities of the present and future are still going through rapid episodes of urban growth. In China, the cities of Hong Kong, Shenzhen and Guangzhou are beginning to amalgamate. This so-called “endless city” has a combined population of approximately 120 million people.

“Africa’s population reached 1 billion in 2009, with estimates that it will double by 2050. Between 2000 and 2100, Africa’s share of the world’s population is expected to rise from 13.1 to 24.9 per cent. Africa’s population is not only the fastest growing in the world, but also the most youthful” (UNEP 2016:16). “In both Africa and Asia, more than half of the population lived in rural areas in 2016, but that share is declining. Between 2016 and 2030, the number of cities with 500,000 inhabitants or more is expected to grow by 80 per cent in Africa and by 30 per cent in Asia” (UN 2016:5). The table below shows the change in population size in 10 selected African cities.

Table 6.2: Change in population size in 10 selected African cities over time (2000-2030) (Source: UN 2016).

	City population in thousands			Average annual rate of change (%)	
	2000	2016	2030	2000-2016	2016-2030
Accra	1 668	2 316	3 262	2.0	2.4
Algiers	2 141	2 632	3 405	1.3	1.8
Cairo	13 626	19 128	24 502	2.1	1.8
Conakry	1 221	1 989	3 134	3.0	3.2
Dakar	2 029	3 653	6 046	3.7	3.6
Khartoum	3 505	5 265	8 158	2.5	3.1
Kinshasa	6 140	12 071	19 996	4.2	3.6
Lagos	7 281	13 661	24 239	3.9	4.1
Nairobi	2 214	4 070	7 140	3.8	4.0
Ouagadougou	921	2 923	5 854	7.2	5.0

“A rapidly growing population stresses ecosystems by increasing demand for food, energy, medicines and water, while bringing distortions to land tenure arrangements, as well as accelerating environmental degradation through soil erosion, deforestation and biodiversity loss” (UNEP 2016:16). Figure 6.1 shows how the amount of land available per person in Africa has shrunk since 1950.

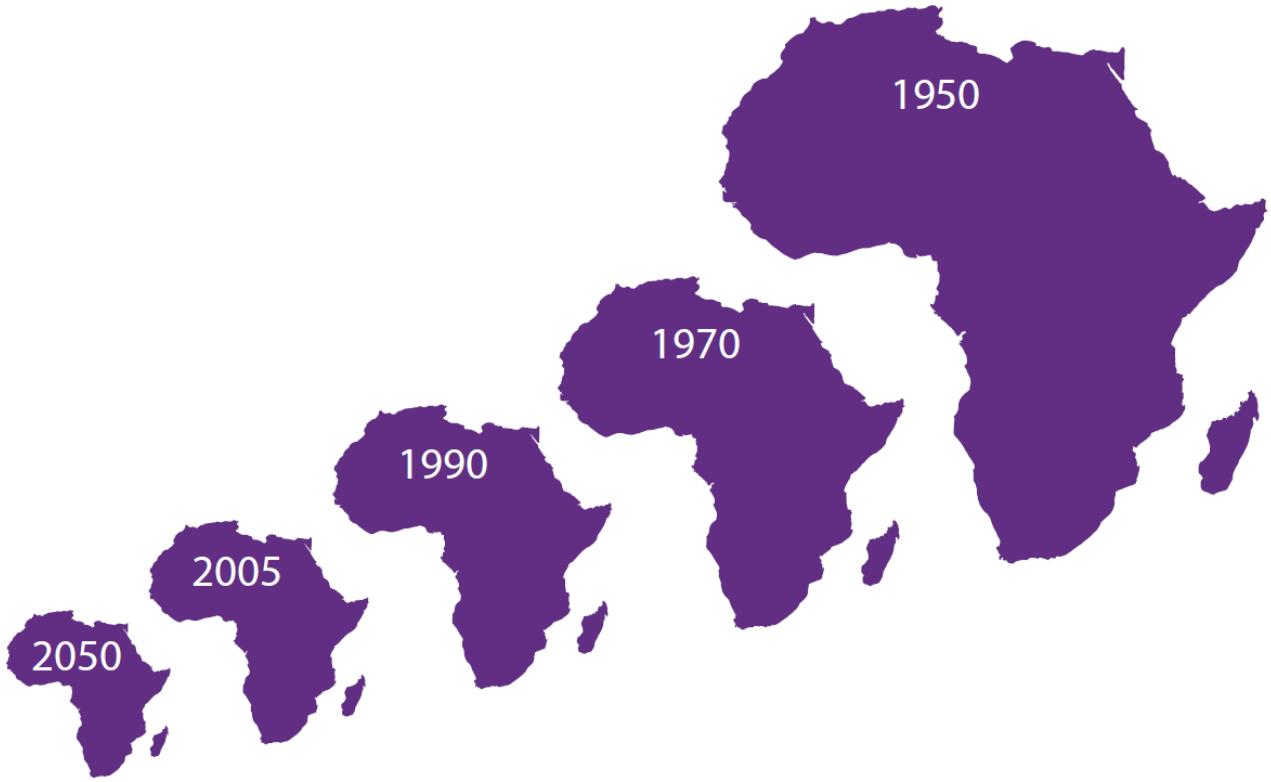


Figure 6.1: Shrinking per person land availability in Africa, 1950-2050 (UNEP 2016:12)

"In extreme cases, competition over scarce resources leads to conflict. In addition, a rapidly growing population presents financial and logistical challenges in service provision, especially in the areas of education, health, safe drinking water and sanitation…With the world's fastest growing population, per person land availability in Africa continues to dwindle and efficient food production technologies are needed to meet the region's nutritional needs while also preserving the integrity and health of land resources". (UNEP 2016:12; 16)

Learning unit activity

- Describe the significance of cities in the Anthropocene.
- Discuss the role of agriculture in the establishment of cities in Mesopotamia.
- Discuss Mumford's critique of the process of suburbanisation.
- Describe how the process of urbanisation has changed over time. In your answer, refer specifically to Mesopotamia, Manchester, Los Angeles and Hong Kong-Shenzhen-Guangzhou.
- Study Table 6.1. Identify the three cities with the largest populations in the year 2016. Name the city whose population size is projected to double from 2016 to 2030. List the five cities with the highest average annual rate of population growth between the years 2000-2016. List the three cities with the lowest average annual rate of population growth between the years 2016-2030.
- Explain how population growth and urbanisation affects resources in Africa.

Reflection activity

- Whitehead (2014:100) claims that we could "…consider our contemporary geological period not as the Anthropocene so much as the *Metropocene*: A period defined by the dynamics and demands of urbanisation". Do you agree with this claim? Give reasons for your answer.
- Mumford argued that suburbanisation often means that many people in the city have further to travel to reach nature and also has the effect of alienating people from each other. Do you agree with this argument? Give reasons for your answer.
- Consult an atlas depicting the largest urban centres on the African continent. In your opinion, which of these cities will amalgamate to form an "endless city" or mega urban region? Give reasons for your answer.

6.4 URBANISATION AND THE ENVIRONMENT

(Reading activity

Study the sections "The environmental blind spot in urban studies" and "Urbanisation and the environment" on pages 109-116 in Whitehead (2014).

Read Case Study 6.

Case Study 6

Efficiency of parks in mitigating urban heat island effect: An example from Addis Ababa

"In the process of urbanization, land cover changes and natural surfaces are replaced by the urban fabric which is characterized by higher temperatures than the surrounding rural environment, a pattern described as urban warming. A large body of urban climate studies have shown that thermal, optical and geometric properties of urban surfaces affect heat absorptive and radiative properties and lead to the so-called Urban Heat Island (UHI) effect" (Feyisa et al. 2014:87).

"The UHI is a global issue that threatens the operation and habitability of our cities and urban environments…The heat island effect is characterised by the development of noticeably higher temperatures in our cities compared with the countryside that directly surrounds them. Initial studies conducted by the World Meteorological Organisation revealed that the UHI effect can increase air temperature in an urban city by between 2 and 8ºC. Recent studies illustrate that a more accurate range is between 5 and 15ºC. The heat island effect arises due to the changing nature of our cities, and is the result of a reduction in vegetation and evapotranspiration, a higher prevalence of dark surfaces with low albedo, and increased anthropogenic heat production" (Mohajerani et al. 2017:522).

"High temperatures in urban areas affect health, economy, leisure activities and wellbeing of urban dwellers. In particular, the health of vulnerable people, such as the old and poor, is highly affected by thermal stress caused by warming. Urban warming may also enhance air pollution, for example by increasing surface ozone concentration with several negative impacts on human health. Furthermore the magnitude and adverse effects of UHI may be intensified as a consequence of global warming. In many tropical countries, where rapid urbanization is undergoing, the intensity and negative impacts of UHI are likely to be substantial.

"Various strategies are being implemented to improve thermal comfort of outdoor and indoor urban environments. Indoor air conditioning facilities may efficiently eliminate thermal stress. However, this strategy may, at the same time, enhance UHI by releasing additional heat to the outdoor environment. …in the summer the cooling demand of a typical office building in Hangzhou metropolitan area of China would increase by 10.8% due to ambient temperature increasing by 0.5ºC. Similarly…electricity consumption in US cities on average increases by 2–4% for every 1ºC increase in temperature and it is estimated that 5–10%of the urban electricity demand is spent on cooling buildings to compensate for 0.5–3.0ºC warming. The increased energy use for cooling may therefore cause other environmental problems such as increased carbon emission. In the context of global climate change, urban buildings are reported to be a major source of greenhouse gas emission. Adaptive strategies of improving thermal environments,

therefore, need to aim at lowering energy use in buildings, thereby also reducing carbon emissions.

“Earlier studies have shown that urban green spaces such as parks can considerably mitigate the UHI effect. The green vegetation can improve both indoor and outdoor thermal comfort, while at the same time providing multiple environmental services, such as carbon storage, reduced air pollution and act as urban biodiversity hotspots. Urban vegetation can also contribute to improving the quality of life and enhancing human well-being through exposure to nature. Integration of green spaces in urban planning and building designs may, therefore, be essential for adaptation to and mitigation of thermal impacts of both local and global warming processes. Complex processes are involved in determining the cooling effect of vegetation on daytime air and surface temperature. The vegetation cools the environment through evaporative cooling, shading effects, and its thermal and optical properties. Compared to impervious surfaces, which generally have high thermal storage capacity and thermal conductivity, vegetation has low thermal storage and admittance and is therefore likely to emit less thermal radiation to the environment. However, the cooling impact of plants on air and surface temperature may vary with environmental factors and plant-specific thermal and optical characteristics. Vegetation with highly reflective surfaces (high albedo) may reduce surface temperature by reducing the amount and intensity of thermal radiation which may also lower local and downwind ambient air temperatures because of smaller convective heat fluxes from cooler surfaces. For instance…coniferous forests have lower albedo compared to deciduous forests, the probable explanation being that conifers trap more radiation due to the rough leaf and canopy structure. An experimental study also indicated that the cooling efficiency of urban parks is mostly influenced by leaf color and foliage density. Plants growing in dry and hot environments have evolved to absorb less radiation through anatomical and physiological adaptations, thereby influencing the thermal environment in a different way than plants in more humid or colder environments. The amount of evaporative cooling and reduction in thermal infrared irradiation emitted from plant leaves likely vary with the evapotranspiration, which, among other things, varies considerably with season, climatic conditions and water availability at the local level. Specific plant species have different adaptations and moisture conservation mechanisms; hence the thermal impact of different species on the environment is likely to vary.

“This study was undertaken in Addis Ababa (9º01’01”N and 38º45’08”E) which is the capital and the largest city of Ethiopia. Addis Ababa is one of the most rapidly expanding cities in the country. According to the Central Statistical Agency of Ethiopia, the total population of Addis Ababa was about 3.041 million in 2012 and the total area of the city was 527 km^2…the city was among the fastest growing cities in Africa with an average annual growth rate of 4.1% between 1990 and 2006. The city is located at altitudes ranging from 2025 to 3028 m. The mean annual temperature range is 16–18ºC. Addis Ababa receives an average rainfall of 1255 mm per year. A review of climate records for over one hundred years shows an increase of minimum and maximum air temperatures in Addis Ababa of 0.4ºC/decade and 0.2ºC/decade, respectively. Twenty-one green

areas (predominantly covered by tree vegetation and with areas ranging from 0.85 to 22.3 ha) were selected.

“In this study we used ground-based air temperature measurements and satellite thermal remote sensing to evaluate cooling effects of parks and examined the relationships between park characteristics and temperature. We conclude that, within the same city, the cooling efficiency of urban tree vegetation varied with park-specific characteristics including species composition, canopy intensity, size and shape of the parks. Moreover, intra-urban variation in altitude also played a significant role in determining thermal variation among parks. Irregular and elongated parks were shown to have lower Park Cooling Intensity (PCI) and higher Park Cooling Distance (PCD) compared to regularly shaped, compact parks. Both PCI and PCD were shown to increase with park size. This study provides insight regarding the importance of evaluating the effectiveness of urban green spaces in mitigating the heat island effect. Understanding differences in cooling effects among parks may help urban planners and greening designers to make appropriate decisions regarding species choice, and size and shape of green spaces. The main recommendations based on this study in terms of maximizing cooling effects of parks are to increase tree vegetation canopy cover, optimize park size and shape, and prioritize the choice of species for greening. Our results suggest that *Eucalyptus*, *Olea* and to some extent *Acacia* are more effective in cooling the urban environment than *Cupressus* and *Grevillea*. However, apart from cooling there are a number of other environmental and social services that are provided by urban green spaces and which need to be considered carefully before deciding about the choice of species. In many instances, urban greening seems to emphasize the aesthetic values of parks and other green spaces and tends to overlook the local climatic influence of vegetation. Hence, urban greening efforts in Addis Ababa and areas with similar environments may need to integrate and optimize the multiple environmental and social values of green spaces.

“Since only 21 green spaces were considered in the remote sensing component of the study and microclimate data were monitored within only 9 of the parks and for only 15 days, the study may not fully represent the diurnal, seasonal and annual variations of the cooling effect of parks. Therefore, further studies need to be undertaken for better understanding the cooling efficiency and for making specific recommendations for city planners. Studies that involve a large number of sample parks from multiple cities and comparison of larger numbers of tree species may provide more generalizable results. Seasonal variation in foliage density and evaporative cooling may need to be explored” (Feyisa et al. 2014: 87-89; 93-94).

Reading organiser

For a significant period of time there was something of an environmental blind spot within urban theory. This blind spot was in part a product of a division that emerged between socio-economic studies of cities as predominately human entities, and environmental studies of those places outside of cities that constituted nature. The unhelpful divide between urban research and environmental studies has been gradually bridged by a series of studies that have explored the ways in which cities are deeply connected to environmental systems at a range of different scales.

Chicago's location meant that it was ideally placed to exploit the environmental resources that were to be found in the heartland of the North American continent – woodlands, fertile prairies and lush rangeland pasture. According to Cronon, the history of urbanisation in Chicago is linked to the ways that the city was able to exploit its hinterland in the Midwest. As a specialised centre for the collation and transformation of agricultural produce, the growth of Chicago into a major metropolis was deeply interconnected with the transformation of the soils and ecosystems of the American Midwest.

The environmental Kuznets Curve offers a helpful starting point when trying to understand urban-environment relations. The general trend suggested by this curve is that early forms of urbanisation tend to be characterised by increasing rates of environmental degradation at a local scale (such as air pollution, resource use, water quality). At some point, the curve suggests that cities pass through a transitional zone, after which, and following a period of economic growth, the levels of local environmental degradation associated with urbanisation tend to decline. As they develop, cities become adept at outsourcing polluting industrial activities, which characterised their early phases of development, to lower cost locations in other parts of the world. A controversial example of globalised environmental pollution is evident in the practices of toxic colonialism. Toxic colonialism is a term that is used to refer to the transport to and disposal of hazardous waste products in less economically developed countries. These toxic substances involved in this process include nuclear waste, dioxins, poisonous metals, persistent organic pollutants (POPs) and sanitary waste, which can all have harmful effects on both ecological systems and human health.

"One of the largest and most publicized e-waste sites in the world is located in Ghana's capital city of Accra. The site, known as Agbogbloshie, originated as a scrap metal recycling site and over the past decade has grown to serve as an important recycling site for e-waste.… At Agbogbloshie, toxic elements arising from the electronic items that are processed, including (but not limited to) arsenic, lead, mercury and copper, have been found in soil, water, ash, sediment and dust collected from the site" (Srigboh et al 2016:69).

Another prominent example of toxic colonialism is the dumping of 500 tons of toxic waste in and around Abidjan, Côte d'Ivoire on the 19th of August 2006. "…The hazardous substances, which belonged to Trafigura, were also dumped at 18 sites around the city while many other possible locations remain unknown to date. Trafigura had decided not to dispose of the toxic waste in the Netherlands because proper disposal costs more there. According to official estimates, 15 people died, 69 people were hospitalised and over 108,000 others sought medical treatment (UN News Centre 2016).

It should be noted that the transportation of waste to less developed countries (LDCs) is not a recent phenomenon. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal came into effect in 1992 following the discovery of imported waste in LDCs (Basel Convention 2011). Since the main emphasis of the Basel Convention is on regulating the trade of wastes, the Bamako Convention was adopted by several African countries in 1998 to prohibit (ban) "…the import into Africa of any hazardous (including radioactive) waste" (UN Environment s.a.).

When the environmental Kuznets Curve is combined with an appreciation of the increasingly globalised nature of urban-environment relations it becomes possible to see how just as cities become more prosperous, clean and verdant, their global ecological footprints may actually be increasing. While Chicago's early development was based upon the exploitation of its surrounding hinterland, it appears that within the Anthropocene the hinterlands upon which cities depend are becoming increasingly global in nature.

The complex nature of the urban-environment relationship is depicted in the "urban" Kuznets Curve. Urban environmental optimists argue that the high concentrations of people and infrastructure that characterise cities mean that they provide an ideal spatial template for developing a low-energy context for human activity. In contrast, urban environmental pessimists are critical of the capacity of cities to provide low-energy and sustainable forms of development. Different types of the cities (industrial, low-rise suburban, megacities or global financial centres) have different types of environmental relations. For example, while global financial centres may support carbon-reduction strategies, they may not oppose the airport expansions. Likewise, property-based urban development planners may find it beneficial to promote urban greening and the improvement of urban air quality, but they find it more difficult to promote less car use and reduce levels of carbon dioxide emissions.

In the context of shortages in the availability of non-renewable resources, and the threats of climate change, we may be entering a new period in the history of urbanisation – *urban ecological security*. In many ways urban ecological security is about the search for competitive advantage in the Anthropocene.

Learning unit activity

- Describe what is meant by the environmental blind spot in urban theory.
- Discuss how Chicago developed through the exploitation of the resources within its surrounding environment.
- "…as cities become more prosperous, clean and verdant, their global ecological footprints may actually be increasing" (Whitehead 2014:115). Evaluate this statement by referring to the urban environmental Kuznets Curve.
- Explain the causes and consequences of toxic colonialism in Africa.
- Briefly describe the measures taken to prevent the exportation of waste to African countries.
- Compare the views of urban environmental optimists with urban environmental pessimists.

- Study Table 6.1 on page 116. Compare the environmental priorities that are supported and contested by rapidly expanding oil-based urban economies with those in centres for consumption-based services and entertainment.
- Explain why urban ecological security is essential to maintain a competitive advantage in the Anthropocene.
- Describe how the urban heat island (UHI) is formed.
- Discuss the consequences of the urban heat island (UHI) on human life.
- Describe the effectiveness of green parks in mitigating the UHI effect with specific reference to Addis Ababa.

Reflection activity

- Revisit the theories on population growth and resource exploitation in learning unit 2. In your opinion, is toxic colonialism in Africa an example of the Malthusian, Cornucopian or (eco-) Marxist perspective? Give reasons for your answer.
- How does your household dispose of electronic waste items?
- Consider the environmental priorities listed in Table 6.1 on page 116 in Whitehead. Which of these priorities does your local municipality support? Why do you think these priorities are supported?
- "The UHI is a global issue that threatens the operation and habitability of our cities and urban environments…" (Mohajerani et al. 2017:522). Do you agree with this statement? Give reasons for your answer.

6.5 KEYSTONE ACTIVITY

"…the political and economic nature of different cities means that they are able to support some environmental priorities, but tend to resist others" (Whitehead 2014:115). Write an essay in which you debate this argument. Support your answer with appropriate examples.

6.6 CONCLUSION

In this learning unit we explored the causes and consequences of urbanisation and its effects on human life and the environment. Moreover, several strategies to reduce the impacts of urbanisation on the environment and the priorities supported by different cities were highlighted. Although the importance of maintaining and protecting environmental resources is widely acknowledged, underlying economic functions and political factors of a particular city play a significant role in the management of these resources.

References

Basel Convention. 2011. *The Convention > Overview*. Available from: http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx. [Accessed on: 20 August 2017].

Feyisa, G.L., Dons, K. and Meilby, H. 2014. Efficiency of parks in mitigating urban heat island effect: An example from Addis Ababa. *Landscape and Urban Planning 123*, 87-95.

Mohajerani, A., Bakaric, J., Jeffrey-Bailey, T. 2017. The urban heat island effect, its causes, and mitigation, with reference to the thermal properties of asphalt concrete. *Journal of Environmental Management 197*, 522-538.

NASA Earth Observatory. 2016. *Nairobi Swells with Urban Growth.* Available from: https://earthobservatory.nasa.gov/IOTD/view.php?id=88822. [Accessed on: 20 August 2017].

Srigboh, R.K., Basu, N., Stephens, J., Asampong, E., Perkins, M., Neitzel, R.L. and Fobil, J. 2016. Multiple elemental exposures amongst workers at the Agbogbloshie electronic waste (e-waste) site in Ghana. *Chemosphere 164*, 68-74.

UN (United Nations). 2016. Department of Economic and Social Affairs, Population Division. *The World's Cities in 2016 – data booklet* (ST/ESA/ SER.A/392). Geneva: United Nations.

UN (United Nations) Environment s.a. *Environmental Governance: The Bamako Convention.* Available from: http://www.unep.org/environmentalgovernance/bamako-convention. [Accessed on: 20 August 2017].

UNEP (United Nations Environmental Programme). 2016. *GEO-6 Regional Assessment for Africa*. Nairobi, Kenya: United Nations Environment Programme.

UN (United Nations) News Centre. 2016. *Côte d'Ivoire: 10 years on, survivors of toxic waste dumping 'remain in the dark,' say UN rights experts.* Available from: http://www.un.org/apps/news/story.asp?NewsID=54699#.WZll8SgjHIU. [Accessed on: 20 August 2017].

LEARNING UNIT 7: GOVERNING THE ENVIRONMENT

Sources to consult:

- **Atlas:** New Orleans, Louisiana; Houston, Texas; Everglades, Florida; Sahel Region in Africa.
- **Prescribed book:** Chapter 7: Governing the environment, pages 123–142 in Whitehead (2014)
- **Case study 7:** Regional and global cooperation in environmental governance
- **Additional resources on myUnisa:** YouTube video, Podcast and PowerPoint

7.1 INTRODUCTION

"Welcome to the Anthropocene. It's a new geological era, so take a look around. A single species is in charge of the planet…" (Pearce 2007, in Whitehead 2014:1). In the Anthropocene Epoch, the governance of the environment can cause or reduce environmental degradation.

This learning unit will focus on the role of governance in environmental issues with specific reference to Hurricane Katrina, the London Fog Disaster and the Florida Everglades. Moreover, theories on environmental governance are explored as well as the ways in which regional and global cooperation may assist in mitigating and preventing environmental degradation in Africa.

7.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to:

- Identify and explain the links between governance and environmental degradation
- Discuss the consequences of environmental degradation associated with nation states
- Assess the impacts of natural weather events and their consequences on human life.
- Describe how remedial actions can reduce or prevent environmental degradation through regional and global cooperation

7.3 PROTECTING PEOPLE FROM NATURE OR PROTECTING NATURE FROM PEOPLE?

Reading activity

Study the section "Introduction: Protecting people from nature or protecting nature from people" on pages 123–125 in Whitehead (2014).

Reading organiser

According to official estimates, Hurricane Katrina was one of the five most deadly hurricanes to strike the US. The total cost of the damage has been estimated at $108 billion and 1 833 deaths were directly linked to the effects of Katrina. The problems that Katrina generated were to these ends, as much a product of human (in)action as they 'were acts of nature'. The floods that followed Katrina were a result of the failure of the levee system that had been designed to protect the urban populations in New Orleans from the water held in Lake

Pontchartrain and the Mississippi River. In many respects, the most serious problems associated with Hurricane Katrina were not caused by the physical impact of the hurricane itself, but are related to technological and political failures within local, national and state governments.

Learning unit activity

- Briefly describe the consequences of Hurricane Katrina on human life.
- Explain the role of the lack of governance in exacerbating the consequences of Hurricane Katrina.

Reflection activity

- In August 2017, heavy rainfall from Hurricane Harvey flooded Houston, in the US state of Texas. Following the intense rainfall event, a levee gave way and a dam overflowed (Jervis & Bacon 2017). Do you think the reasons for the consequences of Hurricane Harvey is similar to Hurricane Katrina? Give reasons to support your answer.

7.4 A BRIEF ENVIRONMENTAL HISTORY OF THE NATION STATE

Reading activity

Study the section "A brief environmental history of the nation state" on pages 125–128 in Whitehead (2014).

Reading organiser

A sovereign state is a political community with a clearly demarcated territory, which can determine its own internal affairs. The nation state can be defined as a differentiated set of institutions and political relations radiate outwards from a centre to cover the territorially demarcated area over which it exercises a monopoly of authoritative rule making. While definitions like these enable us to identify nation states and differentiate them from other forms of political institutions, they can be misleading. Nation states are territorial entities; however, few would claim that their power stops at the border. The contemporary role of the nation state is closely tied to the practices of government. For Foucault, governing involves a sense of care within the operation of states; a care that is directed at national populations, and seeks to ensure that society is ordered in such a way that it can function effectively in relation to the economic production of wealth. Foucault also recognises that the goal of government means that nation states must carefully regulate the relationship between people and the environment, to ensure that the welfare of the population is not compromised in the long term.

In his book *Oriental Despotism: A Comparative Study of Total Power*, the German-American writer Karl Wittfogel (1957) argues that the emergence of early civilisations in places like Egypt and Mesopotamia was based on the control and management of water resources. According to Wittfogel, it was the management of water in arid areas, in the forms of flood defences, irrigation systems and domestic supply, that necessitated the formation of large-scale political bureaucracies. Given the limited sources of available water in such areas, and the need to distribute water over large tracts of land, effective water management could not

be achieved at a local level: it required the formation of what Wittfogel describes as *hydraulic empires*.

During the 18th century, forest resources were a vital source of fuel and building material (used both in the construction of houses and ships) for early state systems. Beyond this, however, forests also represented an important source of fiscal wealth: A product that could be taxed and traded to consolidate a nation's wealth. Scientific forestry enabled state systems to centralise knowledge about forest resources and to predict likely shortfalls and overproductions of timber. Essentially, Scott describes how the establishment of nation states went hand-in-hand with the simplification and standardisation of the natural world. These processes of standardisation and simplification did not apply only to forests but also to water resources, agricultural land and mineral deposits. Governments consolidated their territorial power by developing sophisticated maps of their environmental resources. These maps and surveys increasingly deployed standardised volumetric measures in, and through which, nature could be subject to government calculation.

Learning unit activity

- Define the term 'sovereign state'.
- Describe the aims of nation states and governments as defined by Mann and Foucault.
- Explain the historical links between governance and the exploitation of environmental resources.

7.5 THINKING ABOUT STATE-ENVIRONMENT RELATIONS: GREEN ARBITERS AND ECOLOGICAL LEVIATHANS

Reading activity

Study the section "Thinking about state-environment relations: Green arbiters and ecological leviathans" on pages 128–134 in Whitehead (2014).

Reading organiser

Anarchism is a movement that seeks to oppose the formation hierarchies of power, such as those found within organised religion, science and the nation state. With regards to human-environment relations, anarchists argue that the formation of modern states has resulted in the following three processes:

- The environmental dispossession of people who effectively lose access to once commonly shared resources that are now controlled by the state (including woodlands and water courses)
- A general decline in the ecological knowledge and capacities of people whose previous engagements with the natural world are now administered by state officials and experts
- The general alienation of people from the natural world

Anarchist philosophy suggest a potential paradox within the Anthropocene: Although humans may be responsible for more of what goes on in the global environment, their actual awareness and sense of responsibility for such actions may be diminishing.

The ecological leviathan theory of the modern state suggests that it may have a more positive influence on human-environment relations. Therefore, the state plays a crucial role in protecting the collective interests of society – which may include the sustainable use of natural resources or the preservation of clean air and water. These resources are regarded as common goods that would be neglected if individuals were allowed to simply follow their own selfish interests. It is in this context that states can regulate environmental externalities such as air and water pollution, to ensure that those who economically benefit from causing environmental harm are held accountable.

The central environmental message of Marx's work is that capitalism leads to the subordination of environmental values to those of commercial interest. Marxism tends to see the state less as a referee when it comes to environmental issues and more as an instrument of the ruling economic class. Since wealth creation in capitalist societies is based upon the transformation of nature from its primary forms (wood, minerals, crude oil) into tradeable commodities (furniture, aluminium foil, petroleum), Marxists argue that states tend to do two things, namely:

- Enable the corporate control and transformation of the natural environment into commodities
- Prevent the development and/or enforcement of rules, laws and regulations that would hinder the corporate exploitation of natural resources

An example of state-sponsored exploitation of the environment is the historical role of the Brazilian government in facilitating the exploitation of the Amazonian rainforest. Brazilian governments in the past not only failed to protect rainforests, but also used subsidies and military power to support the interests of logging and ranching corporations over and above those of indigenous communities and the environment.

Learning unit activity

- Discuss the consequences of environmental degradation associated with nation states according to the anarchist theory.
- Explain how Thoreau's work contributed to the establishment of national parks.
- Describe the role of governments in the human-environment relationship according to the ecological leviathan theory.
- Discuss the consequences of private property formation on human life and on the environment.
- Discuss the role of governments in environmental degradation according to the Marxist theory.
- Compare the different state-environment relationships with specific reference to the anarchism, ecological leviathans and Marxist theories.

Reflection activity

- "Although humans may be responsible for more and more of what goes on in the global environment, their actual awareness and sense of responsibility for such actions may be diminishing" (Whitehead 2014:129). Debate whether you agree with this statement.
- Henry David Thoreau argued that "not till we are lost, in other words, not till we have lost the world, do we begin to find ourselves, and realise where we are and the infinite extent of our relations" (1995 as cited in Whitehead 2014: 130). Do you agree with this statement? Give reasons to support your answer.
- Proponents of the ecological leviathan theory suggest that governments play a crucial role in ensuring that polluters are held responsible for their actions. In your opinion, to what extent do nation states fulfil their role in protecting the environment?

7.6 GOVERNING THE AIR: THE CASE OF THE LONDON FOG DISASTER

Reading activity

Study the section "Governing the air: The case of the London fog disaster" on pages 134–137 in Whitehead (2014).

Reading organiser

Since the 1307 Royal Proclamation, which forbade the burning of sea coal, state authorities have been involved in a constant struggle to regulate the air quality in London. During the 19th century, the situation deteriorated. Chemical emissions produced by the alkali industry mixed with the soot and sulphur produced by the burning of coal in industries and residences to create what came to be known as 'pea-soupers' (black fogs). Despite the various forms of national and local legislation that were enacted to regulate air pollution during the 19th and early 20th centuries, such actions only achieved limited success. It was very difficult to monitor and prosecute corporations that broke air pollution laws. In large cities, it was often very difficult to attribute smoke production to any given factory. Moreover, early laws on air pollution tended to only apply to industries rather than residences.

The problems of governing air pollution came to a head in London in December 1952 when a thick fog settled over the city. Cold weather conditions in early December resulted in the burning of high levels of coal within households throughout the metropolis. On 5 December, these high concentrations of soot and sulphur dioxide combined with the cold weather conditions, perpetuating and deepening the fog. These climatic conditions persisted for five days. While London was no stranger to fog, the following three features made this pollution incident particularly problematic:

- The unusual length of its duration
- The thickness of the fog, with naturally produced fog combining with emissions of smoke to produce a dense smog
- The large geographical area that was affected by the fog

These conditions conspired to generate social and economic chaos within the city of London. Early analyses claimed that 4 000 deaths could be directly attributed to the fog disaster, but this figure has recently been revised to almost 12 000.

In response to the London fog disaster, the British state established an expert Committee on Air Pollution in 1953. Given the serious nature of the London fog disaster, and the fact that it had affected all social classes in the city, the British state gained support for drastic action on air pollution. The various recommendations of the Committee on Air Pollution led to the 1956 Clean Air Act. The 1956 Act banned the emission of dark smoke from industrial and domestic chimneys. It also created smokeless zones and smoke control areas in many cities. Finally, it established long-term provisions for the relocation of power stations away from urban centres. These actions reveal the ability of states, when freed from the influence of narrow class interest, to take authoritarian action on environmental issues that can be applied in a uniform way right across a national territory.

Despite the success of the 1956 Act in addressing dark smoke pollution, it is important to note that air pollution continues to be a major problem in Britain today. In a 2007 report, the Royal Commission on Environmental Pollution estimated that air pollution was a contributory factor in 24 000 deaths in the UK every year. A large part of the air pollution problem in the UK is related to the rise of the motorcar. Ironically, clearing the air of dark smoke and soot has generated suitable conditions for the creation of photochemical smog in British cities.

It would appear that the ultimate lesson of the London fog disaster is that while governments may be effective at tackling environmental problems in the short term, in the longer-term economic development will always generate new environmental challenges.

Learning unit activity

- Explain why London is no stranger to air pollution.
- Describe the role of local and national government in regulating air quality in Britain prior to the London fog disaster in December 1952.
- Discuss the causes and consequences of the London fog disaster on human life.
- Explain how the London fog disaster exposed weaknesses in the governance of environmental resources.
- Describe the mitigation measures taken by British authorities after the London fog disaster.
- Explain why the UK still experiences major air pollution events.

Reflection activity

- Despite several measures taken to reduce the levels of air pollution, Kelly (2017) reported "…London breached its annual air pollution limit for 2017 in just five days". In your opinion, is the persistent air pollution problem in London a consequence of poor governance or ignorance by residents who continue to use motorcars? Give reasons to support your answer.

7.7 RIVERS OF GRASS: THE US STATE AND THE FLORIDA EVERGLADES

Reading activity

Study the section "Rivers of grass: The US state and the Florida Everglades" on pages 137–141 in Whitehead (2014).

Reading organiser

The Everglades are at the same time one of the most environmentally important and severely threatened ecosystems in North America. The Everglades provide an important case study in state environmental relations, because the US federal and the Florida state governments have played central roles in supporting the economic exploitation of this region and in championing its conservation. Throughout the 19th and 20th centuries, government supported the reclamation and drainage of wetlands and the construction of levees and a dam around Lake Okeechobee for sugarcane plantations and urban expansion.

The first attempts to actively protect the Everglades came in 1947, when the southern section of the wetlands was dedicated a national park (the Everglades National Park). While protecting a segment of the Everglades from commercial encroachment, the National Park has no jurisdictional power to control the upstream processes that ultimately threaten the sustainability of the wetlands – namely the waterflow from Lake Okeechobee.

During the second half of the 20th century, preventing the continued destruction of the Everglades became a primary concern of American environmental movements. These environmental interest groups were central to the formation of the Comprehensive Everglades Restoration Plan (CERP). The implementation of CERP has, however, encountered a series of setbacks and difficulties. In many ways, these difficulties serve to illustrate the challenges that are associated with governmental interventions in environmental systems. The main problem is that simply allowing the natural hydrological system to return to the Everglades would have flooded large areas of productive agricultural land and generated heightened flood risks in large cities such as Miami and Fort Lauderdale. CERP thus attempts to achieve a complex system of managed flooding, in and through which flooding in some areas of the Everglades is counterbalanced by flood control and water channelling in others. In this context, CERP is less a restoration project and more a watershed management plan.

In many ways, the case of the Everglades serves to illustrate that neither Marxist theories of the state (where the state serves narrowly defined class interests) nor visions of the state as a neutral referee (policing competing economic and environmental interests) effectively capture the nature of the relationships between government systems and the environment.

Learning unit activity

- Discuss the relationship between governance and environmental degradation in the Everglades.
- Describe the reasons for the establishment of the Everglades National Park.
- Explain the role of the Comprehensive Everglades Restoration Plan (CERP) and US authorities in managing and restoring the Everglades.

Reflection activity

"In many ways, the case of the Everglades serves to illustrate that neither Marxist theories of the state (where the state serves narrowly defined class interests) nor visions of the state as a neutral referee (policing competing economic and environmental interests) effectively capture the nature of the relationships between government systems and the environment" (Whitehead 2014: 141). Debate whether you agree with this statement.

7.8 BEYOND THE STATE: THE RISE OF INTERNATIONAL SYSTEMS OF GOVERNMENT

Reading activity

Study box 7.3 on page 133 in Whitehead (2014).

Read case study 7.

Case study 7

Regional and global cooperation in environmental governance

Dell'Angelo et al. (2017:120) contends that in order to overcome the disparity in environmental governance between more developed countries (MDCs) and less developed countries (LDCs), 17 Sustainable Development Goals (SDGs) were adopted by the member countries of the UN General Assembly in September 2015. These goals were developed on the concept of sustainable development as "…the harmonization of economic, social and environmental aspects of development, benefitting current generations without compromising the capabilities and opportunities of future ones" (Dell'Angelo et al. 2017:120). According to UNDP (2017) the goals "…are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity". The 17 SDGs are:

1. No poverty
2. Zero hunger
3. Good health and well-being
4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Piece, justice and strong institutions
17. Partnerships for the goals (UNDP 2017)

Meeting global goals on land management

Land is the main base for other environmental and natural resources. In Africa, the sustainable use and management of land is particularly important because the majority of people, particularly in sub-Saharan Africa, rely on agriculture for food security, and therefore health and poverty reduction. The selected land-related Global Environmental Goals (GEGs), are contained in:

- Agenda 21; General Assembly Resolution 62–98 of 31 January 2008;

- the Millennium Development Goals (MDGs);
- the Ramsar Convention on Wetlands; and
- the United Nations Convention to Combat Desertification (UNCCD).

The land GEGs are complemented by SDG 15 adopted along with 16 other SDGs at the end of 2015. SDG 15 highlights both the importance of land to development and the enduring concern that unless remedial action is urgently taken, the resource faces the risk of irreversible degradation. The Goal, which seeks to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss," is further broken down into 10 Targets. Commendably, the Targets provide a roadmap for implementation of SDG 15 by stipulating that the Goal should be incorporated into national policies through local planning, development processes, poverty reduction strategies and accounts by 2020.

According to the latest national accounts global forests assessment of the Food and Agriculture Organization of the United Nations (FAO), the rate of deforestation has slowed around the world over the last five years, including in Africa, a development that augurs well for the achievement of SDG 15. Moreover, Africa reported the highest annual increase in the area of conserved forest over the same period. This has been attributed to improved measuring and monitoring of forest resources and greater involvement of local communities in formulating policies. However, forest degradation remains a challenge because forest erosion is gradual and more difficult to detect, necessitating a combination of data sets to highlight its extent.

Both deforestation and forest degradation are largely driven by accelerated urbanization and industrialization, agricultural expansion, commercial logging, and increased fuelwood collection. The latter is a reflection of the region's growing energy deficit, where two thirds of the population – around 620 million people – have no access to electricity which is at odds with SDG 7 which aims to "ensure access to affordable, reliable, sustainable and modern energy for all."

All the region's countries are party to the United Nations Convention to Combat Desertification (UNCCD). Forty-two countries have submitted National Action Programmes (NAPs), which are the principal instruments for implementing the UNCCD at national level. Only six of these countries (Burundi, Comoros, Eritrea, Lesotho, Liberia and Namibia) have aligned their NAPs to the current UNCCD 10-year strategy. It is not clear how many NAPs have been integrated into the national development plans. Each of the NAPs feeds into one of the five Sub-Regional Action Programmes (SRAPs) and into the Regional Action Programme (RAP).

Under the UNCCD process, the African Union created the TerrAfrica partnership to scale up investment, knowledge sharing and coalition building for sustainable land and water management in 24 countries. The Great Green Wall for the Sahara and the Sahel Initiative was formed under TerrAfrica to address desertification and land degradation in the Sahel and Sahara, boost food security, and build communities' resilience to climate

change. The Sahel and West Africa Programme, which falls under the Great Green Wall Initiative, consists of an investment portfolio of USD 1 billion to support projects in 12 countries: Benin, Burkina Faso, Chad, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan and Togo. To the extent that desertification is both human and climate-induced, efforts should be made to address climate change (SDG 13). Many African countries have enacted national policies on climate change mitigation and adaptation and are aggressively promoting programmes such as reducing emissions from deforestation and forest degradation in developing countries (REDD+) and its derivatives….

As an affirmation of the importance of both Agenda 2063 and Agenda 2030 as defined by the Sustainable Development Goals (SDGs), Africa's future will contain common elements for a development trajectory that will provide the region with a healthy living environment while ensuring good health and quality of life for her people… Scenarios offer a particularly useful tool for exploring the implications of different futures. Scenarios are 'what if' narratives, creating a range of different future worlds, each exploring a different direction in which drivers of change could develop and interact. Scenarios have been used effectively as a tool to test and develop plans and policies for development, environment and adaptation" (UNEP 2016:46-49; 51; 110).

Four scenarios were developed by the World Wildlife Fund (WWF)/African Development Bank (AfDB) 2015 African Ecological Futures report (2015 as cited in UNEP 2016:111). "After a process of developing sectoral scenarios with various stakeholders on the continent, this final set of scenarios was developed at the 15th African Ministerial Conference on the Environment (AMCEN) in Cairo in March 2015 and published in May 2015, making it the most recent set of regionally-applicable participatory scenarios for the continent, which provide a legitimate, credible set of future pathways… The scenarios outline a future Africa in which governance is more centralized and planned or more decentralized, and where trade is more regionally focused on the continent or looks more to global exports" (UNEP 2016:110). Figure 7.1 below depicts the focus of the four scenarios envisioned by UNEP (2016).

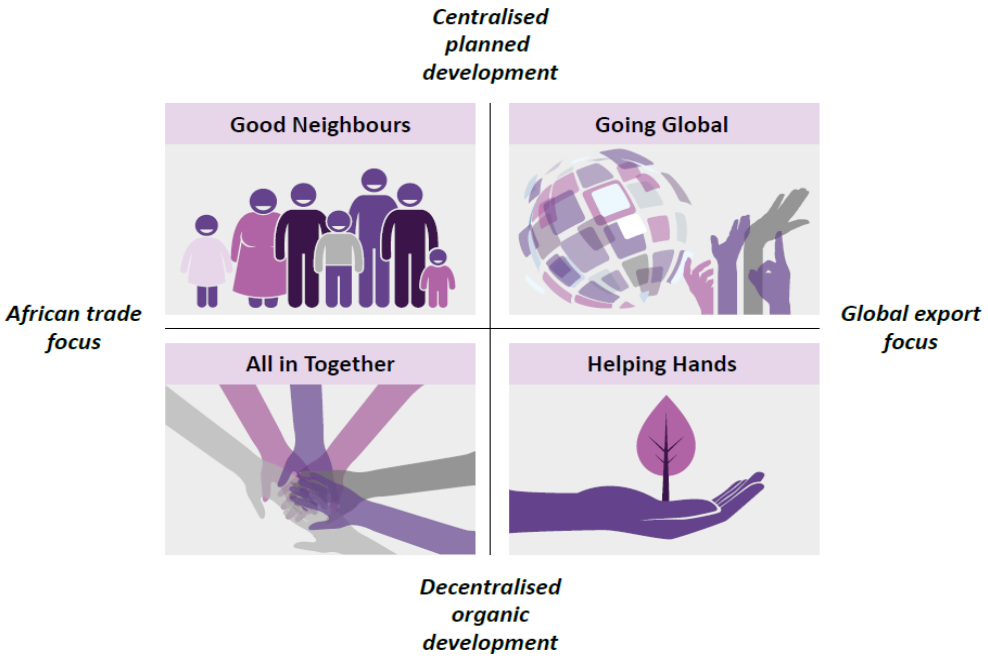


Figure 7.1: Africa's ecological future according to four scenarios (UNEP 2016:111)

"…The scenario analysis specifically sets out to understand the extent to which the Sustainable Development Goals (SDGs) and the African Union's Agenda 2063 Vision are…achieved, depending on the scenario. The analysis emphasizes the use of the SDGs as related goals that should always be considered as a full set rather than treated selectively" (UNEP 2016:111). Although there are four scenarios presented by UNEP (2016), we will focus on the two scenarios based with African trade foci – *Good Neighbours* and *All in Together*.

Good Neighbours scenario

"A difficult but ultimately largely successful transition to centralized planning forms the core of Africa's governance structure by 2030 and beyond, backed by increased intra-Africa trade over global exports. Following the vision outlined in Agenda 2063, and supported by the AfDB's Programme for Infrastructure Development in Africa (PIDA), there is major investment in infrastructure for energy supply, water, food security, and transport and trade.

Africa is witnessing increased investments in the water and energy sectors, and road infrastructure. This leads to the region partially achieving energy security goals under the SDGs by 2030, and more fully by 2063, while also increasing food security and working towards an end to hunger and malnutrition. However, the large-scale investments in infrastructure and the heavy dependence on the region's abundant natural resources take a heavy toll on biodiversity and ecosystems, and resulting feedbacks on ecosystem services counteract the achievements toward the SDGs to some degree.

While centralized planning systems increase efforts to minimize impacts through implementation of environmental regulatory measures, transboundary agreements and

protected areas, the risks of environmental degradation persist due to large regional infrastructure expansion into previously inaccessible areas coupled with the development of trade corridors. There is localized dispossession of land among families living in the paths of such infrastructure projects…Despite the advent of large-scale infrastructure development that relies heavily on natural resource extraction, leaders are driven by the new global agenda for sustainable development and recognize the co-benefits of mitigating climate change and improving air quality through emission reductions. There is therefore a doubling of efforts to decouple emissions from economic growth. This is achieved by reducing the carbon intensity of energy, having an overall positive impact on public health, particularly in areas near power plants.

In the Good Neighbours scenario, there is strong political will for sustainable development and environmental governance, providing many opportunities that can be leveraged; challenges and responses revolve mainly around capacity to enforce, manage and stimulate good governance of natural resources while supporting socio-economic development" (UNEP 2016:111-113;127).

All in Together scenario

"This scenario is characterized by national sovereignty and action at local levels, where there is widespread community action towards more sustainable resource use, more climate-smart agricultural practices and more integrated conservation efforts, supported by international funding from donor countries, social entrepreneurs and other funding sources. However, the scenario is also characterized by a failure to take this diversity of social and technical innovations to a higher scale. In this scenario, Africa's efforts to manage its natural capital sustainably are hampered by pockets of conflict, with regional efforts playing a leadership role in conflict resolution through Regional Economic Communities…

In order to fight lawlessness and cross-border crime, subregional communities become more integrated as a way of bringing peace. Eventually, pockets of ecosystems flourish in well-managed agricultural areas and community-supported protected areas. Transboundary natural resources such as freshwater and fish stocks are most affected by the lack of effective governance at the international level.

Overall, there is a strong risk of leaving behind those who are not able to access the social, knowledge and financial capital to join the 'new Africa' of sustainable local innovation. Natural environments and resources also risk degradation and fragmentation outside these sustainable innovation hotspots. Africa's vulnerabilities to shocks have to do mainly with the focus on local resilience to relatively local stressors. Large-scale shocks such as prolonged droughts, migrations, conflicts, and shocks because of mismanagement of transboundary resources (such as sudden changes to river systems) are difficult to deal with at the local level.

In All In Together, the main challenge, and the main opportunity, is to complement the flurry of local-level innovations and community action with higher-level support, legislation, monitoring and enforcement by state and nonstate actors, while providing leadership in the face of larger scale challenges" (UNEP 2016:115; 118; 129).

Reading organiser

While nation states continue to be prominent actors in the regulation of human environmental relations in the Anthropocene, it is important to acknowledge that environmental government capacity is increasingly being developed at international levels. In the context of the forms of large-scale environmental issues that cross national state boundaries – such as climate change, ozone depletion and acid rain – it has become increasingly apparent that multilateral action is required to effectively address these challenges.

Learning unit activity

- List three environmental issues that cross international boundaries.
- Briefly describe the difficulties with managing environmental degradation on a global scale.
- List the SDGs that specifically address the protection of environmental resources.
- Describe how regional and global cooperation in the achievement of SDGs can reduce or prevent land degradation on the African continent.
- Compare the challenges and opportunities of *Good Neighbours* and *All in Together* scenarios.

Reflection activity

- Consider the list of SDGs in case study 7. Identify five SDGs that you think can be adopted by your local municipality. Motivate why these SDGs would be effective at a local scale.
- The *Good Neighbours* (centralised development) and *All in Together* (decentralised development) scenarios offer different views on the future exploitation of resources in Africa. Which of these scenarios do you support? Give reasons for your answer.

7.9 KEYSTONE ACTIVITY

Write an essay in which you debate whether the anarchist, ecological leviathan or Marxist approaches to governing the environment is best suited to address the environmental issues on the African continent.

7.10 CONCLUSION

In this learning unit, we have explored the different roles that governance can play in environmental issues. Regional and global cooperation seems vital in assisting national states in Africa with mitigation and adaptation to transboundary environmental issues.

References

Dell'Angelo, J, D'Odorico, P and Rulli, MC. 2017. Threats to sustainable development posed by land and water grabbing. *Current Opinion in Environmental Sustainability 26*, 120-128.

Jervis, R and Bacon, J. 2017. *'GET OUT NOW': Levee breached near Houston in Hurricane Harvey aftermath*. Available from: https://www.usatoday.com/story/news/nation/2017/08/29/rain-river-thousands-stranded-hurricane-harvey-continues-pummel-houston/611143001/. [Accessed on: 30 August 2017].

Kelly, F. 2017. *London should lead in showing electric cars will not tackle air pollution*. Available from: https://www.theguardian.com/environment/2017/aug/04/london-should-lead-in-showing-electric-cars-will-not-tackle-air-pollution. [Accessed on 30 August 2017].

UNDP (United Nations Development Programme). 2017. *Sustainable Development Goals*. Available from: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html. [Accessed on: 22 August 2017].

UNEP (United Nations Environment Programme). 2016. *GEO-6 Regional Assessment for Africa*. Nairobi, Kenya: UNEP.

8 fLEARNING UNIT 8: GREENING THE BRAIN

Sources to consult:

- **Atlas:** Switzerland, India and Morocco
- **Prescribed book:** Chapter 8: Greening the brain: Understanding and changing human behaviour, pages 143-161 and chapter 9: Misanthropy, adaptation and safe operating spaces, pages 162-163 in Whitehead (2014)
- **Case studies 8.1 and 8.2:** Conscientious consumption and renewable energy policies in Morocco
- **Additional resources on myUnisa:** YouTube video, Podcast and PowerPoint

8.1 INTRODUCTION

One of the key challenges in addressing environmental degradation is the overexploitation and overconsumption of resources. In this learning unit, we will highlight the causes and consequences of resource overconsumption, with special reference to the consumption patterns of household appliances in South Africa. Additionally, the role of human behaviour together with environmental policies (including a case study based on Morocco) are explored as instruments to reduce or prevent environmental degradation.

8.2 LEARNING OUTCOMES

After completing this learning unit, you should be able to:

- Identify and explain the links between human behaviour and environmental degradation.
- Analyse and describe the causes and extent of environmental degradation associated with resource consumption.
- Assess the possible consequences of overconsumption with reference to case studies.
- Describe how environmental policies can reduce or prevent environmental degradation.

8.3 HUMAN PSYCHOLOGY IN THE ANTHROPOCENE

Reading activity

Study the section "Introduction: Human psychology in the Anthropocene" on pages 143-144 in Whitehead (2014).

Reading organiser

Researchers contend that although humans like to think of themselves as rational decision makers (carefully weighing up options to guide important decisions), a significant portion of human behaviour is driven by irrational (emotional) prompts to action.

In the example of climate change, it appears that those living in the poorer parts of the world – who have contributed least to global warming – will experience many of the worst effects of climate change. Therefore, it is argued that without a direct, emotional connection to the consequences of climate change, it will remain difficult to motivate people in more developed

countries (MDCs) – who are the main emitters of greenhouse gases (GHGs) – to reform their carbon-emitting behaviours.

Learning unit activity

- Describe the barriers to establishing environmentally sustainable patterns of human behaviour.

Reflection activity

> "… without a direct, emotional connection to the consequences of climate change, it will remain difficult to motivate people in more economically developed countries (who are the main producers of greenhouse gases) to reform their carbon-producing behaviours" (Whitehead 2014:144). Do you agree with this statement? Give reasons to support your answer.

8.4 CHANGING PATTERNS OF HUMAN BEHAVIOUR AND THEIR ENVIRONMENTAL CONSEQUENCES

Reading activity

Study the section "Changing patterns of human behaviour and their environmental consequences: Fordism and the Great Acceleration" on pages 144-149 in Whitehead (2014).

Read case study 8.1.

Case Study 8.1*

Conscientious consumption

"Green economy", "sustainability" and "green growth" are all concepts that have been introduced to promote economic welfare while taking into consideration aspects other than economic progression. These concepts have to some degree promoted a more holistic approach in the quest for "green growth"; meaning a green economy that prioritises social welfare and poverty eradication and promotes non-monetary valuation of the natural environment (Death 2014). Unfortunately, this approach is often refuted by the fact that society has, through social pressure, created a culture where consumption beyond a point of actual need is acceptable and repeated in the pursuit of success and happiness (Burroughs & Rindfleisch 2002; McCollough 2009; Pereira Heath & Chatzidakis 2012). This overconsumption may even be justified and excused in an emerging economy such as South Africa, since it is viewed as a reflection of economic progress, poverty alleviation and the country's overall development as mirrored in the Gross Domestic Product (GDP) (Hamilton & Denniss 2005; Khanna & Palepu 2010). South Africa's GDP has in recent years benefitted in particular from vast increases in the spending patterns and consumption of a newly emergent middle-class consumer segment (PwC 2015; 2012), However, the GDP was never meant to be used as an exclusive indicator for a country's well-being, since it focuses solely on national income and omits social and environmental indicators (Kuznets 1934; Talberth et al 2007). Globally, consumption patterns (that contribute to GDP growth) have already reached unsustainable levels. South Africa, as an emerging economy has the alarming potential

to further increase the global environmental footprint, exceeding the already strained regenerative capacity of the earth's renewable resources (WWF 2012).

Even though a rapid surge in the consumption patterns of South African citizens indicates growth on a certain level, it holds opposing negative consequences for the country's environment since current consumption practices cannot be maintained (Rogers and Ryan 2001; WWF 2012). This adds to pressure placed on the country and the world's natural resources and if these resources are depleted, it will hold severe consequences for current and future generations. As an example, increased energy consumption, beyond the point of actual necessity, has had severe consequences for the entire South African economy in recent years (Inglesi 2010; Lombard & Ferreira 2015; Pollet et al 2015). Researchers have firmly established that overconsumption contributes to climate change and widespread resource depletion, of which the current water shortage in South Africa is another clear-cut example (Strengers 2011).

Notwithstanding the environmental consequences related to overconsumption, many South African consumers, who previously did not have access to assets, are rapidly increasing their consumption to ultimately better their well-being (Nieftagodien 2005), which in turn correlates with the notion that increased spending power and consumption will lead to higher levels of happiness (Burroughs & Rindfleisch 2002). Yet, it has been well established that consumption of objects as a means for comfort and happiness is unattainable (Belk 1985) and does not translate into greater levels of well-being for the individual (DeLeire & Kalil 2010). In fact, tendencies related to an unsustainable addiction to economic prosperity, which results in unfulfillment, have been labelled "affluenza" (Hamilton & Denniss 2005).

Studies done in emerging economies are indicative of a highly skewed consumption pattern of the population (Burgess & Steenkamp 2006). In a South African context, Rosenberg (2006) states that a select few of the total population is responsible for more than half of the overall consumption of the country. To address these imbalances and measure true wealth on either a national or an individual level, various measurements should be taken into consideration other than economic prosperity alone, since this may not be a true reflection of well-being (Ura et al 2012; Talberth et al 2007). Governments can put policies and programmes into place to curb overconsumption, but this problem should be addressed on an individual level as well (Lorek & Spangenberg 2014; Pereira Heath & Chatzidakis 2012; Steg & Vlek 2009). If consumers continue in the current manner of overconsumption and discounting the future discounting (Hill et al 2008), sustainable progress as a means to improve overall well-being, will not be achievable (WWF 2012).

The relevance of the aforementioned arguments culminates in the fact that the concept of sustainability requires a more encompassing approach. To date, much attention has been focused on the eradication of poverty and the growth of the economy within a Third World environment, with limited attention devoted to the unsustainable practices of the more affluent segments of the population (Lorek & Spangenberg 2014; Mittelman sa;

Rogers & Ryan, 2001). Sustainable development is defined by Talberth et al (2007) as the "non-declining level of well-being for future generations". Moreover, sustainability as a need of consumers may have three underlying dimensions, namely, economic, which is long-term financial commitments for the household (Erasmus et al 2005); environmental, meaning resources required that have an impact on the environment (Cabeza et al 2014); and social, meaning consumption decisions that shape and maintain a person's self-identity and social status (Jackson 2005). These three components must be met in equilibrium to achieve sustainable consumption in the long term (United Nations Conference on Environment and Development 1992 cited in Talberth et al 2007).

One of the major areas of wasteful and overconsumption practices, which is also known as one of the fastest growing industries in South Africa, is the household appliance industry. Examples of household appliances are refrigerators, washing machines, dishwashers, and so forth. The household appliance industry is also known as the white goods industry (Erasmus et al 2005; McCollough 2009; PwC 2012). With the country's increasing middle-class consumer, came the escalation of the consumption of white goods. Since the emerging middle class may have (and still might) feel deprived in relation to other consumers who already own such appliances, accumulating these appliances became more of a status symbol to "Keep up with the Joneses", rather than to serve merely as functional appliances. Furthermore, the technological advancements of the appliance industry are rendering appliances outdated much sooner than previously experienced (Hamilton & Denniss 2005), which have contributed to the growth of this industry. The growth has led to excessive consumption of resources (such as water, energy in the form of electricity consumption, metals – galvanised or stainless steels mostly, ceramics and glass), which in turn has contributed to a worldwide energy (Du Pont 1998) and water crisis (WWF 2014). The current national energy predicament (Du Plessis & Randewijk 2014; Inglesi 2010; Inglesi-Lotz 2011; Lombard & Ferreira 2015; Pollet et al 2015) and water scarcity and/or shortage problems (Binns et al 2015) also referred to as a water crisis (The Water Project 2016), should serve as encouragement for consumers to consider the consequences of their consumption decisions. Household appliances require the use of resources from the *initial phase of production* (resources required to make the product), *throughout the use of the product* (water, electricity consumption and materials required for maintenance throughout the duration of use) and lastly *when discarding the product* (the materials that are not biodegradable or recycled, ends up on landfills). Consumers should consider the consequences of their use of white goods, since such appliance purchases have several implications for an individual on economic, environmental and social levels (Du Pont 1998; Erasmus et al 2005; Girling-Budd 2004; Jackson 2005). Environmentally friendly white goods have in most industries and in most product categories been priced at a premium over the conventional product offerings, especially in the major household appliance category (Erasmus et al 2002; Peattie & Crane 2005). Yet, future rewards offered by these environmentally friendly merchandise options are often highly beneficial for the consumer regarding long-term economic and energy savings. This should inspire consumers to delay immediate gratification that is achieved through the purchase of conventional non-environmentally friendly and cheaper household appliances. By rather opting for the more expensive,

"greener" appliance, the consumer's ecological footprint is reduced and increased individual well-being is accomplished by, for example, increasing people's long-term economic savings through reduction in resource consumption and thus, by implication, their consideration for natural resources as well as for their social standing, in accordance to various theoretical perspectives.

This is in line with the Sustainable Development Goals. Goal number 12's purpose is to *ensure sustainable consumption and production patterns*. It also aims to produce goods and services that improve the quality of human life by not only increasing net welfare gains from the economic activities, but also by minimising the consumption of resources and emission of pollution throughout the entire lifecycle (manufacture, use and disposal) of a product (UN 2016a).

*This case study was written by Ms L Christie (Lecturer: Department of Life and Consumer Sciences, University of South Africa).

Reading organiser

The Great Acceleration represents a key stage in the history of human-environment relations, during which significant increases in the rates of human-induced environmental change occurred. Th e three proxies of the Great Acceleration are:

- Rising levels of carbon dioxide in the atmosphere, which has increased from 310 ppm in 1950 to 406 ppm in 2017 (Tenenbaum et al 2017)
- Rising levels of nitrogen (from fertilizers) in the oceans
- Increases in sulphur dioxide concentrations in the atmosphere

Since the end of World War II, MDCs adopted Fordist economic practices. Fordism is associated with the rise of mass production, which made it possible to produce commodities in ever-increasing quantities, and at ever-decreasing cost. Fordist societies recognised that it was only through the provision of reasonable incomes for workers that a mass market could be produced that would be able to consume goods. Rising levels of income also led to an increasing emphasis on comfort and convenience within the home with the installation of central heating systems, showers and timesaving appliances such as the washing machine and dishwasher. Fordism helped to create homes that required much higher levels of energy to sustain it and thus placed a much greater demand on environmental resources. Beyond energy use in the home, Fordism is synonymous with the rise of private car ownership.

There are certain things that we need to consume on a regular basis, such as food to eat. Beyond that, there are more luxury items that we now perceive as necessary items, for instance computers and televisions. Wants are different to needs to the extent that they are things that we could survive without. We do, however, increasingly buy things that we want because we associate the purchase of these goods and services with pleasant feelings.

The modern tendency towards the overconsumption of goods has had social and environmental consequences. Social consequences are related to the emergence of the "affluenza virus" within the western world. Affluenza is a form of social illness, in and through which we tend to judge ourselves – and those around us – based on what we have and own, and pursue happiness through the continued purchase of goods. In environmental terms, our contemporary patterns of overconsumption place significant pressure on the environmental resources that are used to produce these goods. At the same time, the rapid rate at which products become obsolete (either due to technological advances or because of changing social fashions) means that society is producing over greater amounts of waste products that must be disposed of. Recent estimates on ecological footprints claimed that if the whole world consumed resources at rates similar to that in the UK, we would need 3.1 planets to provide all of the resources required. If Switzerland's consumption rate were mirrored throughout the world, we would require 2.8 planets, but if we all operated at India's rate of consumption, we would require only 0.4 planets.

Huxley's novel *Brave New World* explore the potential future that lay in wait for a society that was dedicated to mass production and consumption. Huxley's Fordist future is a place where drugs are used to ensure the population remains obedient and dedicated to continued mass consumption. The reuse and repair of old goods, as a barrier to consumption, is discouraged (with activities such as knitting and sewing becoming crimes).

The Voluntary Simplicity Movement (VSM) is a movement that emphasises the value of simplifying our complex and increasingly stressful lives. The principles of the movement rely on the concept that "everything you own, owns you; you have to care for it and store it". Voluntary simplicity encourages individuals to avoid the burdens associated with overconsumption and re-evaluate the things that are of real importance in their lives.

Learning unit activity

- Explain the meaning of the concept "Great Acceleration". Identify three proxies of the Great Acceleration.
- Discuss the role of Fordism in the overconsumption of resources.
- Provide a definition for the term "affluenza". Explain the consequences of affluenza on the environment.
- Describe Huxley's theory on the potential consequences of overconsumption.
- Compare the Voluntary Simplicity Movement's (VSM) views on overconsumption the with those of Miller.
- Briefly discuss the meaning of the term "green growth".
- Explain why overconsumption is often justified in less developed countries (LDCs).
- Describe the causes and consequences of the overconsumption of resources. In your answer, refer specifically to the white goods industry in South Africa.

Reflection activity

- An example of overconsumption by the emerging middle-class consumer in South Africa is that of white goods (household appliances).
    - In your opinion, why are these goods significantly contributing to the country's consumption?
    - Name another example of overconsumption by the affluent portion of the population in South Africa.
- In your opinion, can the consumption of environmentally friendly white goods (household appliances) assist with achieving sustainability?
- Compile a list of white goods in your household. Identify which of these products are used in your household every day. From this list, can you identify the goods that have been purchased based on having a smaller ecological footprint?
- Revisit the theories on population growth and resource exploitation in learning unit 2. Whitehead (2014:149) claims "… if the whole world consumed at rates similar to that in the UK we would collectively require 3.1 planets to provide all of the resources required". In your opinion, are the ecological footprints of MDCs examples of the Malthusian, Cornucopian, Peakist or Marxist perspective? Give reasons to support your answer.

8.5 UNDERSTANDING HUMAN BEHAVIOURS: RELIGION, SCIENCE AND IDEOLOGY

Reading activity

Study the section "Understanding human behaviours: Religion, science and ideology" on pages 150-153 in Whitehead (2014).

Reading organiser

A number of perspectives or frameworks tries to explain human behaviour towards the environment. These perspectives attempt to understand how affluent societies could create mass production and consumption systems.

The biological perspective suggests that by the very nature of human evolution as a species – competing with other species and exploiting environmental resources as best we can – we tend to be "by nature aggressive, materialistic, utilitarian and self-interested".

In his theory – *The Empathic Civilisation* – American economist Rifkin (Whitehead 2014) argues that despite long-held beliefs that humans are inherently self-interested and individualistic, humans are a naturally emphatic species. He further relies upon the work of biologists who suggest that there are "mirror neurons" in the brain, which mean our brains have a "predisposition for empathetic response" when we see distress in other mammalian species.

Some theorists have claimed that the emergence of organised religion – particularly in the Judeo-Christian tradition – lies at the centre of our exploitative environmental conducts. Lynn White Jnr claims that Christianity has generated a situation where humans believe that they are superior to the rest of nature and that scientific and technological interference with the environment is justified.

Neil Smith claims that it is neither biology nor religion, but capitalism that has laid the foundations for current patterns of environmental exploitation. By objectifying nature, capitalism has made it much easier for people to accept the large-scale transformation of resources since long commodity chains and complex market place exchanges obscure the environmental consequences of these actions.

Learning unit activity

- Compare the perspectives that attempt to explain humanity's behaviour towards the environment.

Reflection activity

- In your opinion, which of the abovementioned perspectives are the most accurate in explaining human behaviour towards the environment? Give reasons to support your answer.

8.6 CHANGING HUMAN ENVIRONMENTAL BEHAVIOURS: BEYOND *HOMO ECONOMICUS*

Reading activity

Study the section "Changing human environmental behaviours: Beyond homoeconomicus" on pages 153-155 in Whitehead (2014).

Reading organiser

The figure of *Homo economicus* is a type of 'economic person' who lives out life as a rational market actor. The term *Homo economicus* was coined on the belief in rational human action. In a market economy, the efficient distribution of goods and services requires humans to respond to price signals in a rational way: Buying the things they want at the most competitive prices.

There are different ways to shape decision-making without having to revert to the coercive powers of law and legislation. Examples of policies for environmental behaviour change are listed in table 8.1.

Table 8.1: Market-based policy options for environmental behaviour change

Policy instrument	Policy example
Creation of market	Carbon trading/pollution permits
Information provision	Green marketing/smart energy meters
Tax/ financial penalty	Carbon tax/ pollution fees
Subsidy	Tax breaks for micro-energy generation schemes

Australia and the European Union have established carbon markets in and through which companies can trade greenhouse gas emission permits with each other. By giving GHG emissions a price, a rational incentive is provided for companies to reduce their emissions and enhance their profits.

Research in economics, behavioural psychology and neuroscience has started to cast serious doubts on the rationality assumptions associated with *Homo economicus.* At the heart of these studies has been recognition of the significant role that emotions and irrationality play in human decision making and behaviour. Corporations have been exploiting the emotional aspects of our decision making to influence our consumption patterns through advertisements, the design of supermarkets and other prompts to encourage us to consume their products in ever-greater quantities. However, the idea that humans are *predictably irrational* provides an opportunity for policy makers to design environmental strategies that can coax human action away from mass consumption.

Learning unit activity

- Describe the concept *Homo economicus* and its dependence on rational behaviour.
- Discuss the economic strategies that can be used to promote change in resource consumption patterns.
- Explain the role of irrational (or more-than-rational) human behaviour in resource consumption.
- Describe how insights of behavioural psychology can reduce overconsumption.

8.7 POLICY PERSPECTIVES ON PRO-ENVIRONMENTAL BEHAVIOUR CHANGE

Reading activity

Study the section "Policy perspectives on pro-environmental behaviour change" on pages 157-161 in Whitehead (2014).

Reading organiser

Disclosure refers to the ways in which corporations or public bodies disclose the impacts that their products and services have on the environment. An example of an environmental disclosure policy is the US government's Toxic Release Inventory. This inventory requires that corporations disclose the amount of harmful materials that they are releasing into the environment. Although the Toxic Release Inventory does not necessarily stop polluting activities, it forces corporations and individuals to be more aware of their impacts on the environment (and how consumers and peers judge these impacts). Remarkably, without legally requiring changes in the ways people behave towards the environment, the Toxic Release Inventory has been associated with significant reductions in toxic pollution in the US.

New environmental behaviour change policies can also combine disclosure with peer pressure. An example of this initiative is the UK government's encouragement to energy suppliers to not only disclose the amount of energy used of an individual, but also how this compares to other consumers' level of energy use.

Future bias exists when we prioritise present needs or desires over longer-term benefits. Future bias is a major barrier when it comes to domestic investment in renewable technologies. While investment in renewable technologies involves a significant financial outlay in the present, its financial benefits are only recovered over a much longer period.

Environmental policies that target the irrational aspects of humans are based upon a more nuanced understanding of why humans behave in harmful ways towards the environment. These new policy initiatives have become subject to numerous critiques. Given that many of these initiatives seek to exploit people's emotional responses to behavioural prompts, some critics have suggested that they may reflect forms of social manipulation that, even when pursued in the common environmental good, are unethical and undermines democratic processes. The *Common Cause* report argues that many environmental behaviour change policies use short-term psychological strategies to shift behaviour, while not addressing our deeper socio-cultural values. This report suggests that policies should devote more attention to the adoption of non-materialistic, egalitarian and biocentric values by humans.

Learning unit activity

- Briefly describe the factors that led to the emergence of pro-environmental behaviour changing policies.
- Discuss the role of disclosure and peer pressure in environmental policies in the US and UK.
- Explain how future bias to investment in renewable energy is addressed in the UK.
- Describe the critiques of environmental behaviour change policies.

Reflection activity

- Corporations exploit irrational aspects of human behaviour to increase consumption levels. Do you think it is ethical to use pro-environmental behaviour policies (that may also be considered as forms of social manipulation) to decrease consumption levels?

8.8 MISANTHROPY, ADAPTATION AND SAFE OPERATING SPACES

Reading activity

Study the section "Conclusions: Misanthropy, adaptation and safe operating spaces" on pages 162-163 in Whitehead (2014).

Read case study 8.2.

Case study 8.2

Renewable energy policies in Morocco

In general, renewable energy policies are instruments that can be used to achieve SDGs 7 and 13 (*ensure access to affordable, reliable, sustainable and modern energy for all*; and *take urgent action to combat climate change and its impacts*) (UN 2016b;c).

"… The rapid increase in energy prices and recent geopolitical events serves as a reminder of the importance of energy at accessible prices has on economic growth and human development, as well as vulnerability of the global energy system to shortages. The protection of energy sources is often found at the top of the international political agenda. However, the current standard energy sources are accompanied by threats of

grave and irreversible damage to the environment, including world climate alterations. The impacts of climate change are now too evident to be disputed.

As the Stern Review points out, it would be too costly to tackle the challenge of climate change if the world procrastinates in taking actions. Several regulatory instruments at global, national and regional levels have been created to reduce greenhouse gas (GHG) emissions. The Kyoto Protocol, an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), sets binding targets for 37 industrialised countries for reducing the GHG emissions. Simultaneously, the Kyoto Protocol provides the possibility to Annex B countries to reach part of their targets through three types of flexible mechanisms to reduce GHG emissions: Joint implementation (JI), international emission trading (IET) and clean development mechanism (CDM).

While the emissions trading mechanism is the driving force behind the suite of cooperative mechanisms, the CDM gives the possibility for developed countries to receive credits from relatively low-cost emissions reductions. Actually, achieved reductions are translated into Certified Emission Reductions (CERs), and every credit amounts to 1t of CO_2 equivalent. Once verified and certified, these credits can then be used as one means of meeting the investor's "assigned amount" obligation.

Given the problems associated with identifying promising projects, quantifying the magnitude of the reductions, and monitoring the results, some means of reducing those barriers was clearly called for. In response, the Climate Investment Funds (CIFs) were established in 2008 by the World Bank to serve as an intermediary for encouraging CDM reductions in greenhouse gases. The CIFs are composed of two separate trust funds – the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF) – each with a specific scope, objective, and governance structure. The SCF aims to help developing countries prepare for climate change by promoting low-carbon, climate resilient development. The CTF seeks to provide financing – principally to larger emerging economies and to regional groups – for demonstrating, deploying, and diffusing low-carbon technologies with the potential for long-term avoidance of greenhouse gas emissions. The fund promotes renewable energy and energy efficient technologies in the power sector as well as energy efficiency strategies in the transportation, building, industrial, and agricultural sectors.

Morocco, officially the Kingdom of Morocco, is a country in the Maghreb region of North Africa. Its eastern border is with Algeria and a relatively narrow body of water separates it from Spain to the north. Prediction of climatic change and global warming studies demonstrated that Morocco is among the countries that are more likely threatened by climatic change. According to the International Energy Agency (IEA), Morocco's GHG emissions from fuel combustion were estimated at about 42.1Mt CO_2 in 2008, and are expected to rise quickly (more than double by the year 2020). This increase is mainly due to the growth of the residential sector and the energy sector. To contribute to the efforts of the international community to reduce the climate change impact, Morocco signed the UNFCCC during the Earth Summit in Rio de Janeiro in June 1992, ratified it in December

1995 and set it into force on 27th March. In the same spirit, the country setup a National Committee on Climate Change in 1996 and a National Scientific and Technical Committee in 2000, while in 2001 Morocco organised the COP-7 and submitted its first National Communication on Climate Change (October 2001). The Kyoto Protocol was ratified on 25th January 2002 and has been entered into force on 16th February 2005.

As mentioned above, a CDM is a key approach to support climate change protection efforts on a global level, including emerging and developing countries like Morocco, which traditionally lacks fossil fuels, but possesses significant renewable energy potential, particularly solar and wind resources … .

Morocco's energy profile is dominated by importing fossil fuels. Currently, Morocco imports about 96%of its supplies of energy resources. Energy consumption has risen at an average annual rate of 5.7% from 2002 to 2011. This dependency on energy imports makes Morocco highly vulnerable to increases in international fuel prices, putting a heavy fiscal burden on the national budget. Petroleum represents nearly 61% of the overall national energy consumption. Morocco's electricity demand rose on average by about 5% per year in the past five years and is expected to increase by 7–8.5% per year in the next ten years. In 2011, electricity consumption was 28.8TWh, 8.4% more than the previous year. About 81% of the country's electricity production is based on fossil fuels like: coal, oil and natural gas. Coal power plants, fuelled by importing hard coal, form the backbone of the country's generation system. With 1.8GW of installed capacity (Morocco's total capacity is 6.4GW), they contribute about 45% of the country's forecasted electricity production of 26.5TWh … .

It is interesting to note, that the ministry of Energy, Mines, Water and Environment (MEMEE) estimates two scenarios for the electricity demand growth rate by 2020. The first scenario is the "base" scenario; the electricity growth rate is 6.9% per year and that almost double the demand load in 2010. The second scenario is the "disruptive" scenario with a 8.7% annual growth rate, this means that the electricity demand will increase by a factor of 2.3 by 2020 which makes the peak load for average day rising from less than 4 000 MW in 2010 to about 9 000 MW by 2020. Hence, Morocco will face in future possibly huge energy costs if prices continue to increase. The main underlying energy challenges for Morocco are how it can achieve secure and stable supply and reduce the country's energy bill, which has an extremely negative impact on its trade deficit.

The national strategies currently underway to pursue low-carbon opportunities, to achieve economic and social national aims are the National Energy Strategy (NES) of Morocco and the related National Plan of Priority Actions (PNAP). The development of the NES and the PNAP was launched by His Majesty King Mohammed VI on April 15, 2008. The PNAP rests on four strategic axes:

- Security of supply with diversification of fuel types and origins.
- Access to energy for all segments of society at competitive prices.
- The promotion of renewable energy and energy efficiency.
- Regional energy integration among the euro-Mediterranean markets.

The national energy strategy aims to develop renewable energy to meet 20% of the country's domestic energy needs and increase the use of energy efficiency to meet 12% by 2020 and 15% by 2030 … .

It is important to note that recently, Morocco is actively promoting build-operate-transfer (BOT) and independent power project (IPP) contracts, which seek to award long-term agreements to private sector actors. The country has opted for a competitive bidding process to get a competitive tariff rate.

To assist Morocco in its efforts to increase security and reduce its vulnerability to oil price shocks, a fully government owned fund, called Fond de Développement de l'Energie (FDE) is being setup. It currently has $1 billion, consisting of contributions of $500 million from the Kingdom of Saudi Arabia, $300 million from the United Arab Emirates and $200 million from Hassan II Fund. Coordination is delegated to the MEMEE. The Government currently plans to invest the majority of the FDE funds with the intention of generating returns for the state. For that purpose, it has created an investment fund (called *Société d'Investissements Energétiques* or SIE). It will make equity investments in financially viable energy projects. Such projects will include, but will not be limited to, power generation from renewables. SIE is currently taking a three-tier position as (i) an anchor investor, (ii) a co-developer and (iii) a fund-leveraging institution.

A Clean Technology Fund (CTF) Investment Plan for Morocco, published in October 2009, proposes co-financing of 150 million dollars to support the Moroccan FDE. The CTF resources should support an institutional transformation to create a lasting funding mechanism that will significantly increase future investment strategy to enhance energy security, while simultaneously pursing low-carbon opportunities. By providing this additional funding, financial closure can be achieved for projects aiming at the greatest potential for GHG emission reductions, but face financial challenges due to additional costs or risk premiums. Furthermore, the CTF will promote energy conservation measures such as industrial energy efficiency and urban transport …" (Kousksou et al 2015:47-49).

Examples of investments in wind and solar energy projects in Morocco are highlighted in the paragraphs below.

"According to the National Energy Strategy, the Moroccan Integrated Wind Energy Project was launched in 2010, with an estimated investment of MAD31.5 billion (approximately US$3.7 billion) and aims (i) to increase the share of wind power in the national energy balance to 14% by 2020, (ii) to achieve a production capacity from wind power of 2GW and annual production capacity to 6600 GWh, corresponding to 26% of current electricity generation and (iii) to save1.5 million tons of fuel annually and prevent the emission of 5.6 million tons of CO_2 per year …

Morocco has recently announced an ambitious plan for the development of Integrated Solar projects combined with combined cycle units. The project would to a saving of

1million Toe and 3.7million tons of CO2 emissions per year and aims to: _ build 2000MW of solar capacity by 2020 on five sites (Ouarzazate (500MW), Ain Beni Mathar (400MW), Foum Al Ouad (500MW), Boujdour(100MW), Sebkhat Tah(500MW)) … ." (Kousksou et al 2015:50;52).

Reading organiser

Although thinking about the Anthropocene appears to require us to place humans at the centre of environmental studies, there are dangers within this anthropocentric perspective. Even though we may worry over the long-term environmental impacts of human development over the last 6 000 years, some may take solace in the fact that humans are in charge of the biosphere and can address ecological problems. Nevertheless, this immodesty can lead us to forget that humans are still only one part of the planetary system. Failing to acknowledge the natural limits that exist to human development could have devastating consequences for both the environment and human wellbeing. However, discussions of the Anthropocene can create a fertile breeding ground for misanthropy – the hatred of humans. Supporters of the deep green perspective argue that the response to the imbalances in the global ecosystem should prioritise the needs of the environment over those of humans.

Several environmental policies and awareness campaigns, aimed at changing human behaviour towards the environment, have been launched in recent years. These campaigns are regarded as instrumental in maintaining safe operating limits (preventing resource depletion and limiting environmental degradation). Examples of these campaigns are Earth Hour and Earth Overshoot Day.

The purpose of Earth Hour is to raise awareness about climate change. It encourages participants to switch off the lights at their homes, offices and landmarks for one hour (WWF 2017). "Earth Overshoot Day marks the date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year. We maintain this deficit by liquidating stocks of ecological resources and accumulating waste, primarily carbon dioxide in the atmosphere" (Global Footprint Network 2017). In 2017, 2 August was marked as Earth Overshoot Day. To address the annual resource depletion, a campaign was launched to "move Earth Overshoot Day backwards" and proposes changes in lifestyle choices and overall reduction in food waste.

Learning unit activity

- Evaluate the statement: "… if the Anthropocene illustrates anything at all, it is the fact that we cannot go back to nature (even if we wanted to). The global environment is now an irrevocable product of society and nature" (Whitehead 2014:163).
- Explain why Morocco is extremely vulnerable to crude oil price increases.
- Describe how Morocco's environmental policies can reduce or prevent environmental degradation associated with climate change and energy insecurity.
- Discuss examples of solar and wind energy projects in Morocco.

8.9 KEYSTONE ACTIVITY

Several environmental policies and awareness campaigns, aimed at changing human behaviour towards the environment, have been launched in recent years. Examples of these campaigns are Earth Hour, Earth Overshoot Day and World Environment Day. Write an essay in which you debate the effectiveness of the abovementioned campaigns with specific reference to resource consumption in the Anthropocene Epoch.

8.10 CONCLUSION

In this learning unit, we discussed the overconsumption of resources along with behavioural factors that are at play in the human-environment relationship. Although close examination of consumer patterns challenge population growth theories (Malthusian perspective), it should be noted that the current rates of resource exploitation exceeds their renewability (Peakist perspective). Additionally, the methods used by corporations to encourage continued consumption of goods may reflect aspects of the Cornucopian perspective. Overconsumption can also be regarded as an example of Marxist perspectives since the ecological footprints of MDCs significantly overshadow those of LDCs.

Substantial forms of environmental degradation (water scarcity, air pollution, climate change, soil erosion and pollution, deforestation, biodiversity loss, harmful waste disposal and modification of local climates) are associated with the Anthropocene Epoch. However, it is important to note the role of human activities and behaviour in taking remedial measures to reduce or prevent environmental degradation.

References

Belk, RW. 1985. Materialism: Trait aspects of living in the material world. *Journal of Consumer Research 12*, 265-280.

Binns, JA, Illgner, PM & Nel EL. 2001. Water shortage, deforestation and development: South Africa's working for water programme. *Land Degradation and Development 12*, 341-355.

Burgess, SM & Steenkamp, JEM. 2006. Marketing renaissance: How research in emerging markets advances marketing science and practice. *International Journal of Research in Marketing 23*, 337-356.

Burroughs, JE & Rindfleisch, A. 2002. Materialism and well-being: A conflicting values perspective. *Journal of Consumer Research 29*, 348-370.

Cabeza, LF, Ürge-Vorsatz, D, McNeil, MA, Barreneche, C & Serrano, S. 2014. Investigating greenhouse challenge from growing trends of electricity consumption through home appliances in buildings. *Renewable and Sustainable Energy Reviews 36*, 188-193.

Death, C. 2014. The green economy in South Africa: Global discourses and local politics. *Politikon 41*, 1-22.

Deleire, T & Kalil, A. 2010. Does consumption buy happiness? Evidence from the United States. *International Review of Economics 57*, 163-176.

Du Plessis, D & Randewijk, PJ. 2014. Smart home: Energy management system for demand side management. *Proceedings of the First International Conference on the use of Mobile Informations and Communication Technology (ICT) in Africa UMICTA* 2014, 9-10 December 2014, STIAS Conference Centre, Stellenbosch: Stellenbosch University, Department of Electrical and Electronic Engineering, South Africa.

Du Pont, PT. 1998. *Energy policy and consumer reality: the role of energy in the purchase of household appliances in the U.S. and Thailand*. Unpublished PhD Thesis. Delaware: University of Delaware.

Erasmus, AC, Boshoff, E & Rousseau GG. 2002. Elicitation and generation of a script for the acquisition of household appliances within a consumer decision-making context. *Journal of Family Ecology and Consumer Sciences 30*, 46-64.

Erasmus, AC, Makgopa, MM & Kachale, MG. 2005. The paradox of progress: Inexperienced consumers' choice of major household appliances. *Journal of Family Ecology and Consumer Sciences 33*, 89-101.

Girling-Budd, A. 2004. *Comfort and gentility: furnishings by Gillows, Lancaster*, *1840-1855*, in *Interior design and identity* edited by McKellar, S. and Spark, P. Manchester: Manchester University Press.

Global Footprint Network. 2017. *About Earth Overshoot Day*. Available from: http://www.overshootday.org/about-earth-overshoot-day/. [Accessed on 7 September 2017].

Hamilton, C & Denniss, R. 2005. *Affluenza. When too much is never enough*. Crows Nest, New South Wales: Allen and Unwin.

Hill, EM, Jenkins, J & Farmer, L. 2008. Family unpredictability, future discounting, and risk taking. *The Journal of Socio-Economics 37*, 1381-1396.

Inglesi, R. 2010. Aggregate electricity demand in South Africa: Conditional forecasts to 2030. *Applied Energy 87*, 197-204.

Inglesi-Lotz, R. 2011. The evolution of price elasticity of electricity demand in South Africa: A Kalman filter application. *Energy Policy 39*, 3690-3696.

Jackson, T. 2005. *Motivating sustainable consumption: a review of evidence on consumer behaviour and behavioural change*. A report to the sustainable development research network. Guildford: University of Surrey.

Khanna, T & Palepu, KG. 2010. *How to define emerging markets*. Available from: http://www.forbes.com/2010/05/27/winning-in-emerging-markets-opinions-book-excerpts-khanna-palepu.html. [Accessed on 21 May 2014].

Kousksou, T, Allouhi, A, Belatter, M, Jamil, A, El Rhafiki, T, Arid, A & Zeraouli, Y. 2015. Renewable energy potential and national policy directions for sustainable development in Morocco. *Renewable and Sustainable Energy Reviews 47*, 46-57.

Kuznets, S. 1934. National income, 1929-1932. *National Bureau of Economic Research Bulletin 9*, 1-12.

Lombard, A & Ferreira, SLA. 2015. The spatial distribution of renewable energy infrastructure in three particular provinces of South Africa. *Bulletin of Geography: Socio-economic Series 30*, 71-85.

Lorek, S & Spangenberg, JH. 2014. Sustainable consumption within a sustainable economy – beyond green growth and green economies. *Journal of Cleaner Production 63*, 33-44.

McCollough, J. 2009. Factors impacting the demand for repair services of household products: the disappearing repair trades and the throwaway society*. International Journal of Consumer Studies 33*, 619-626.

Mittelman, R. sa. *Green consumer behaviour in emerging markets: A review of research*. Available from: https://www.academia.edu/2136336/Green_Consumer_Behaviour_in_Emerging_Markets_A_Review_of_Research. [Accessed on 29 August 2016].

Nieftagodien, S. 2005. *Ownership, income and race: Further analysis of the black affluent in South Africa*. Conference of the Economic Society of South Africa, 7-9 September 2005, Durban.

Peattie, K & Crane, A. 2005. Green marketing: legend, myth, farce or prophesy? *Qualitative Market Research: An International Journal 8*, 357-370.

Pereira Heath, MT & Chatzidakis, A. 2012. 'Blame it on marketing': consumers' views on unsustainable consumption. *International Journal of Consumer Studies 36*, 656-667.

Pollet, BG, Staffell, I & Adamson K-A. 2015. Current energy landscape in the Republic of South Africa. *International Journal of Hydrogen Energy 40*, 16685-16701.

PwC. 2012. *South African retail and consumer products outlook.* Available from: http://www.pwc.co.za/en_ZA/za/assets/pdf/retail-and-consumer-products-outlook-2012-2016.pdf. [Accessed on 21 October 2013].

PWC. 2015. *The World in 2050: Will the shift in global economic power continue?* Available from: http://www.pwc.com/gx/en/issues/the-economy/assets/world-in-2050-february-2015.pdf. [Accessed on 18 October 2016].

Rogers, M & Ryan, R. 2001. The triple bottom line for sustainable community development. *Local Environment 6*, 279-289.

Rosenberg, E. 2006. Consumerism in *The Enviropedia. Be the change you want to see,* edited by D Parry-Davies. Simonstown. Echo-Logistic Publishing.

Sadr, SMK, Mashamaite, I, Saroj, D, Ouki, S & Ilemobade, A. 2015. Membrane assisted technology appraisal for water reuse applications in South Africa. *Urban Water Journal 13*, 536-552.

Steg, L & Vlek, C. 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology 29*, 309-317.

Strengers, Y. 2011. Negotiating everyday life: The role of energy and water consumption feedback. *Journal of Consumer Culture 11*, 319-338.

Talberth, J, Cobb, C & Slattery, N. 2007. *The genuine progress indicator 2006: A tool for sustainable development*. Oakland, CA: Redefining Progress.

The Water Project. 2016. *Water in crisis – South Africa*. Available from: https://thewaterproject.org/water-crisis/water-in-crisis-south-africa. [Accessed on 18 October 2016].

UN (United Nations). 2016a. *Progress of goal 12*. Available from: https://sustainabledevelopment.un.org/sdg12. [Accessed on 19 April 2017].

UN (United Nations). 2016b. *Progress of goal 7*. Available from: https://sustainabledevelopment.un.org/sdg7. [Accessed on 5 September 2017].

UN (United Nations). 2016c. *Progress of goal 13*. Available from: https://sustainabledevelopment.un.org/sdg13. [Accessed on 5 September 2017].

Ura, K, Alkire, S, Zangmo, T & Wangdi, K. 2012. *An extensive analysis of GNH Inde*x. Thimphu: Centre for Bhutan Studies.

WWF (World Wide Fund for Nature). 2012. *Living planet report 2012*. Gland: WWF.

WWF (World Wide Fund for Nature). 2014. *Living planet report 2014*. Gland: WWF.

WWF (World Wide Fund for Nature). 2017. *What is Earth Hour?* Available from: https://www.wwf.org.uk/earthhour/what-is-earth-hour. [Accessed on 7 September 2017]