

Geography Exam Notes

Unit 3 and 4

Unit 3:

Ecosystems:

Are made up of 4 main components:

1. Abiotic (non-living) - sunlight, humidity, inorganic substances such as water
2. Producers - convert solar energy into chemical energy
3. Consumers - Reliant on other organisms for nutrients. Herbivores and Carnivores
4. Decomposers - Breakdown dead organic matter and waste matter

Natural Biome:

A biome is a community of life forms adapted to a large natural area

May cover a region made up of a number of ecosystems and refer to the biotic components of that region.

Often named after the dominant vegetation type in the area and the abiotic element

Agricultural Environments:

Have various types including commercial, subsistence and intensive farming

Sustainable farming practice is used in the natural environments as the negative impacts can include pollution of soil, water and air, and destruction of the natural environment

Urban Environments:

Typically consists of any area of concentrated settlement forms, or buildings, where the majority of inhabitants are involved in non-primary and non-agricultural forms of production and is another example of an anthropogenic biome

Approx. 50% of all people now live in cities

Land Cover Change:

Refers to the natural, physical and biological (living) elements on the earth's surface

Is the changes that have taken place to natural environments due to a variety of natural and/or human induced causes

Natural = Cyclones, Bushfires

Anthropogenic = Agriculture, Urban Areas

Occurs as a result of population growth and consequential increase in the need for food and shelter

Biodiversity Loss:

Biodiversity refers to the number, type and variety of biotic (living) organism found within an environment or ecosystem

Biodiversity loss is when there is a decrease (loss) in the number, type or variety of living organism within an environment or ecosystem

Climate Change:

Long term permanent shift in some or all parts of the weather conditions

Climate change includes an areas climate changing from periods of warming (interglacial) to periods of cooling (glacial)

Sustainability:

Meeting the needs of current generations without compromising the needs of future generations through simultaneous environmental, economic and social adaptations and improvements

Urban Land Cover:

Although it is a relatively small area, the land that is required to support urban areas undergoes a total transformation and has the greatest influence on global environmental change of any anthropogenic land cover

Urban sprawl = suburbs far away from city centre

Projected that within this current rate of land cover change, almost 50% of the Amazon rainforests could be lost by 2030, and by 2060 no rainforests remaining

Global Forests Land Cover:

Responsible for providing oxygen, absorbing carbon dioxide, regulating temperature and weather patterns and provides habitats for up to 80% of the world's terrestrial biodiversity

Global Forests:

Forests cover approximately 30% of the Earth's surface. Global forests are continually being deforested at a rapid rate

The United Nations Food and Agricultural Organisation (FAO) estimates that the rate of global forests land cover change is 7.3 million hectares of forest being lost each year. Over half of the world's tropical rainforests have already been cleared. 20 football fields a minute
17% of Amazon rainforest lost

90% of West Africa's coastal rainforest since 1900s.

Agricultural Land Cover:

Commercial or Subsistence. Involves growing crops and/or raising of livestock. Total of 38% of the world's, and 54% of Australia's land is used for agricultural purposes.

Palm Oil plantations in Indonesia have increased from 2.024 million hectares in 1995 to 8.99 million hectares in 2014, with a projected increase up to 20 million hectares by 2050.

Increased intensification of agriculture in Europe, North America, India and China is an example as well as Singapore's 'Sky Greens' vertical farming.

Spatial Modelling:

Is a methodology or set of analytical procedures used to derive information about present and future spatial relationships between geographic phenomena.

Once potential impacts are identified for various regions and biomes, mitigation and adaptation strategies can be developed and implemented

Spatial modelling is used to project changes in land cover and incorporates both environmental and socio economic variables.

Environmental variables take into account the natural ecological processes occurring within biomes at the local scale. GIS = Geographical Information System - data creates maps

Socio economic Variables take into account factors such as population growth and density, methods of energy production and demographics plus economic activity and growth at a local scale and the influences of globalisation and economic interdependence at the global scale. Scenario-based projections attempt to take into account many of the processes and factors driving land cover change.

Scenario based models may produce a number of outcomes or scenarios based on the variables considered. Quantitative measures = Based on Numbers, Qualitative measures = Based on words

Land use change models are often based on data gathered from remote sensing and Geographical Information System (GIS)

Scenario Framework developed by the Intergovernmental Panel of Climate Change (IPCC) are often used as the base of such modelling

Series of maps will be produced to show the predicted changes over time .

World Population, Affluence and Advances in Technology:

Between 1900 and 2000 the World Population multiplied 3x faster than in all of previous human history

Estimated that by 2050 population will reach 9 billion

In 2007, the global urban population became larger than that of the rural population

Three main factors which will influence the worlds population and its growth rate:

1. Humans are living much longer
2. The Majority of all population growth will occur in urban areas in developing nations
3. Fertility rates are declining

The population growth rate is steadily decreasing since its peak in 1960.

The fertility rate is an average measure of how many children per woman in a country will be born

The replacement rate is the rate required to ensure that the population does not decrease
Improved health care which reduces the infant mortality rate and therefore reduces the needs to have more children in case of death, the increase costs of raising children in more wealthy nations, increased education rates of women and also higher participation rate in the workforce.

Affluences is having a great deal of money and wealth

The higher the level of wealth in the country the higher the demand for resources and technologies.

Currently 20% of the worlds population consumes 80% of the worlds resource s

This has seen a trend of global displacement land use, meaning that the wealthier nations move away from producing goods and rely on the less wealthy nations to produce them.

Land use is moved to the less wealthy nations instead.

The Industrial Revolution in the 18th Century saw the introduction of technology and machine development which allowed for large scale production.

Affluence and 'technology hungry' populations worsened environment quality.

The more affluent countries are investing in the development of tech that will be greener and allow arable land to be more productive

Processes of Land Cover Change:

Growth of Urban Settlement and Urbanisation:

Will see more of the worlds people living in the cities or the metropolitan areas surrounding cities

Contain more than 50% of the world's population

They change the colour and smoothness of land surfaces thus affecting heat budget and water cycle. Monitored by satellite technology.

Deforestation:

The removal or clearing of forests generally for other uses such as agriculture and urban development

It is estimated that between 74,000 to 93,000 km² are removed each year

Brazil has the highest level of 17% of the Amazon forest already deforested in the last 50 years.

Land Reclamation:

Land is gained or created from the sea, wetlands or riverbeds

Flevopolder in the Netherlands which is the largest artificial island in the world.

Mainly used for agricultural production.

Singapore and Tokyo also have large tracts of reclaimed land, used predominantly for industry or port facilities.

Expansion and intensification of agriculture:

Increasing the amount of land available which can be used for agricultural activities. This can often involve the deforestation of valuable forest ecosystems or other vulnerable land being cleared.

The intensification of agriculture refers to increasing the productivity of the resources already being used in agriculture. However most agricultural intensification to date has increased pressure on the environment and natural resources.

Land and Soil Degradation:

Land degradation is the decline in the quality and health of natural land resources, includes soil degradation

Degradation occurs due to overgrazing, excessive tillage, erosion, sediment deposition, mining, urbanisation, disposal of industrial wastes, road construction, decline of plant communities and the effects of noxious plants and animals
Estimated since 1960, one third of worlds arable land has been lost through degradation

Desertification occurs if there is continual degradation in drylands ecosystem.

Rangeland Modification:

Lands where the native vegetation is predominantly grasses, grass like plants, savannahs and shrubs

Rangeland ecosystems globally have been under threat due to the expanding agricultural use of them and the introduction of weeds and exotic species

Impacts the ability of rangelands to provide ecosystem services to the population.

This practice is occurring in Australia, USA and many countries in Africa.

Industry and Mining:

In 2014 Australia's exports of minerals and energy was valued at \$195 billion and is an essential elements to the Australian economy.

Illegal gold mining occurs in Venezuela.

Large tracks of land have been cleared for these mines to be established and once they are finished, there is no rehabilitation of the land.

Irrigation:

Irrigation is an artificial method of watering plants for agriculture

Asia has 65% of the worlds areas equipped with irrigation, 17% in the Americas, 9% in Europe, 5% in Africa and 1% in Oceania.

Issues of water rights can arise when regions or countries share water resources, especially if water use in one area impacts areas downstream.

Murray-Darling River basin in Australia.

Factors Affecting the Process of Land Cover Change Across Nations

Australia:

Population size and density:

Australia is the 6th largest country in the world

Area of 7,686,850 square kilometres

Population is approx. 24 million with 88.9% living in Urban areas.

2 cities containing pop over 4 million.

Economic World Standing:

12th Largest economy

Gross Domestic Product (GDP) per capita of \$67,458,36 USD in 2013

16th by the International Monetary Fund

19th by the Word Bank

10th by the CIA. Heavily relies on agriculture and exports for income

Types of Government and Economy:

Local, state and federal or national levels of government exist.

Australia's economy is described as a mixed market economy. This means it has a mixture of capitalism and socialism. This allows for personal economic freedom, but the government is able to interfere in economic activities for social purposes.

It is dominated by the services sector, mining and agricultural exports

Due to the type of government and economy, land cover change in Australia must be agreed upon through federal, state and local governments depending on the location and scale of change pursued.

Rural areas away from urban settlements is where large scale land cover change has occurred in the past.

The continuing dependence on mining, and increasing rates of urbanisation has resulted in most recent land cover change purposes occurring in remote areas where minerals are found and in areas adjacent to existing urban settlements.

Institutional arrangements and land ownership:

Land can be privately bought, owned and sold in Australia.

"Property legislation in all states and territories is based on the Torrens principle of registration of land title. Each state and territory has a central register of all land in the state, which shows the owner of the land. The land title is the official record"

The Environment Protection and Biodiversity Conservation Act 1999 protects native areas.

The Aboriginal and Torres Strait Islander Heritage Protection Act

Australia has a number of different land ownership and land use categories which impact on the processes and amount of land cover change.

Freehold title - rights over land for all time, however must comply to planning and environmental regulations in relation to process and use of the land

Leasehold title - lease land from the government, for an agreed number of years, with access to water and grazing rights and compliance with environmental policies and restrictions

Traditional Land Rights - restricted process and land cover change allowed requiring agreement from Indigenous Australians.

Protected Areas - nature conservation and preservation areas, such as Kakadu, John Forest National Park, Shark Bay World Heritage Area, due to a unique biodiversity and landforms and/or valued landscapes under government act such as the Environment Protection and Biodiversity Act.

Ideology and cultural views:

Australia's society in general greatly values its natural environment and outdoor lifestyle.

Therefore this has significantly influenced land cover change and its process. This has been done through the vocal opinions of stakeholder groups in relation to proposed land cover changes.

Authorities, governments by relevant legislation, must provide individuals and interested parties with the opportunity to comment on proposed changes to land use and land cover.

Environmental impact studies must be conducted and presented to the relevant levels of government.

Rehabilitation plans for areas at risk or degraded by mining activities must be implemented. Stakeholder groups such as Greenpeace, World Wildlife Fund and Planet Ark (at a national level), the Department of Environment

and Conservation Volunteers in Australia (at a state level) and 'Save the Beeliar Wetlands' (at a local community level) can all have an influence in the rate and scale of land cover change in Australia.

China:

Population size and density:

4th largest country in the world

Area 9,595,960 square kilometres.

China's population is approx. 1.4 billion (approx. 19% of the world's pop)

57% living in urban areas, compared to 26% in 1990.

China had 662 cities in 2016, compared to 324 in 1985, 14 cities containing over 5 million people each.

Economic World Standing:

Second largest economy in the world

Falls well below other large economies in terms of GDP per capita. \$6,807 USD in 2013.

Ranked 84th by the IMF (International Monetary Fund)

85th by the World Bank

88th by the CIA.

Types of Government:

China has a centralised, single-party government based on the ideals of the Communist Party.

Communist Party appoints the members of National People's Congress, the President, the Premier, the governors of China's provinces and local mayors.

There are five levels of government that sit under the central National People's Congress, from provincial to village level.

The Communist Government has control over the economy and people for the 'good of the people'

China's economy is a socialist market economy. This means it is largely a state (central government) owned economy because of its communist ideology, however there is also an open market economy. China's economy is largely a manufacturing economy. It is the largest exporter of goods in the world and the second largest importer.

Due to the type of government and economy, China continues to transform large proportions of its land cover as it is continually developing.

A lot of land is needed for agriculture production and its large reserves of coal are being mined to maintain the increasing demands for power generation/

Increasing exports in order to continue to develop its wealth.

Institutional arrangements and Land Ownership:

Hasn't had any real private land ownership as it has all been owned and controlled by the government.

Until 1978, under China's planned economy and fundamental communist ideology, there was no housing market. Post 1978, China experienced reform and a shift of ideology resulting in private housing ownership being recognised as a 'personal consumable commodity'. This increased personal wealth amongst the Chinese and private ownership of houses and apartments.

In Urban areas, whilst properties may now be owned by individuals, the land itself is still owned by the government. In rural areas, farmlands owned by farming collectives where a small number of village leaders have the authority to make decisions regarding the land and its use

Many ecological problems as it has largely gone unchecked by the Ministry of Environmental Protection (MEP). China has experienced less control on rapid land cover change as it has been facilitated by the various levels of government due to the necessities of rapid population and economic expansion.

However in January 2015 new laws allowed for the prosecution of polluters and protection of natural areas.

Ideology and Cultural Views:

China's people have mixed opinions on the environment as their actions are based around cultural beliefs and most importantly the growth of wealth.

To have wealth, the environment in many circumstances has been sacrificed.

The ideology and values of the people of China towards the environment is that they regard human beings as totally different from the world of natural things, and accordingly treat the world of nature as a world of objects.

Therefore the value of nature lies merely in being "used for their purpose"

However, since the 2000s, with China's massive pollution issue and through outside pressures and awareness-raising from worldwide organisations attitudes are starting to change.

Between 2001 and 2005, Chinese environmental authorities received more than 2.53 million letters and 430,000 visits by 597,000 petitioners seeking changes and action on environmental issues.

Pan Yue is executive Vice-President of the Central Academy of Socialism in Beijing. He has called for Wholesale changes to China's development policies and has warned of dire.

Indigenous People's Land Management:

There is no pristine wilderness in Aboriginal lands

They in fact has a complex system of land management

Fire:

System of patch work burnt and regrowth areas. Fire was used to clear vegetation to make it easier to travel. It was also used to promote plant growth in some areas and to flush possums out of their habitats. There were less uncontrolled fires as we often witness in modern times

Caring for Country:

The environment, cultural heritage and natural resource management by Indigenous communities is called 'caring for country'

Tradition methods and moder practices.

Modern practices include;

Protection of cultural sites of significance to Aboriginal people

The mapping and tracking of water source

Knowledge to reduce the risk of bushfires

Impacts of Land Cover Change:

Land cover change impacts upon the water cycle, soil quality, soil erosion, habitat loss and biodiversity.

Loss of ecosystem services and explain changes to regional climates and urban heat islands

Ecosystem services:

Benefit people and communities derive from an ecosystem including flood and disease control, food and water, cultural services and supporting the nutrient cycling.

A loss of food security:

Food security means that a local/regional population is resilient in the event of ecological or natural disasters affecting their food supply.

Where populations have access to a variety of foods, plant and wildlife biodiversity is often maintained or less severely altered. A lack of food security can arise due to reliance on one or two crops or food source.

Health concerns may result due to food shortages or presence of unmanageable levels of wildlife pathogens

A loss of energy security:

The decreasing supply and loss of access to native wood products is a particular concern for these peoples and nations

The consequence of a shortage of this energy supply is that women and children in particular have to spend time travelling long distances to gather more wood rather than spending that time caring for primary needs of community members such as child caring and education

[For countries such as Tanzania wood accounts for more than 80% of fuel needs]

Difficulty in providing clean water:

In many cases healthy, natural ecosystems act as a natural water purification systems. However due to land cover change such as the elimination of marshes and wetlands; the diversion of surface water or alteration of rivers for agriculture; removal of vegetation around watershed areas; and the creation of urban infrastructure, this is impacting on the ability to provide clean drinking water.

Impermeable surfaces, do not allow water to flow through. Therefore runoff is caused, can contain a number of organic, inorganic and metallic pollutants carried into the water bodies or watershed areas.

The World Health Organisation (WHO) has witnessed an increase in the quality and the diversity of pollutants reaching freshwater systems since the 1970's

The removal of the natural vegetation and eventual pollution increases the amount of runoff

Excess nutrients and fertilisers from agricultural activities enter the watershed area, polluting the water, by causing algal blooms (Eutrophication)

Developing countries that rely on rivers for water sources such as Ghana in Africa, where changes in land cover for urban and agricultural land use has meant they are struggling to prevent urban water supply pollution, and in India, where 80% of the Country's rivers are polluted from urban domestic sewerage.

A loss of social relations:

Many indigenous cultures have a strong connection to the land. These connections and storylines also help explain and order of social relationships and interactions within the local tribal groups and wider society
If disrupted it can cause much distress and disconnection in social relations

A loss of freedom of choice:

Loss of biodiversity, impact upon ecosystems, local communities will have decreased access to a wider variety of commodities and the ability to earn income from their production
If healthy ecosystems and biodiversity are not maintained industries will suffer due to the lack of basic materials.
The major consequences will be felt in LDC that rely heavily on these industries for income, particularly in countries such as South Africa, Uganda and Zimbabwe.

Invasion by non-native species:

Another consequence of a loss of ecosystem services is the potential loss of invasion resistance, which means non-native species can invade local biomes and reduce biodiversity in the area.
Catastrophic especially for biodiversity hot spots such as the Busselton-Augusta area. Non native weeds have invaded such as Veldt Grass from southern Africa as well as animals such as rabbits and foxes. Small native marsupials such as the Woylie are under threat as food supplies are reduced.

The lack of pollination of plants:

Reaction of bees; essential for pollination required for many fruits and legs
Bee pop has been reduced due to use of pesticides, the impact of viruses and the Varroa Mite which is a parasite that feeds on the blood of adult bees.

An impact on climate regulation:

Forrest within carbon storage, albedo, evapotranspiration, rising temperature and fire regime
Lack of marine diversity may impact photosynthesis levels, the carbon and nitrogen cycles
Finally, pest, disease and pollution control could proliferate with loss of ecosystem services. In extreme circumstances, loss of biodiversity can lead to species extinction

Water Cycle:

Damming increases evaporation and infiltration in areas
Altering of land cover that changes the surface and vegetation of watershed areas will likely increase the runoff and decrease infiltration. Increases soil erosion of cleared areas.
Irrigation depletes rivers and water tables as well as potentially increases the nutrient run-off from agricultural areas due to the use of fertilisers.

Soil Erosion:

The soil is part of the ecosystem
With greater demand for agriculture commodities comes the need for land cover change as agriculture production expands
Croplands form from grasslands and forests
Impact includes; soil erosion, soil compaction, loss of soil structure, less fertile lands increased levels of soil acidity due to fertilisers
As a result of farming processes there are clogged waterways and soils become more prone to flooding

Loss of Habitat and Biodiversity:

Loss of habitat refers mainly to deforestation and degradation of forests.

Has occurred due to the expansion of agricultural land, increasing in demand for timber and other forest products, and overgrazing

Loss of biodiversity linked with loss of habitat. Human activity is known to have decimated 869 species and placed a large number of species at the brink of extinction.

Depth Study 1: Linking Land Cover and Climate Change:

The Earth's climate has always changed with long periods of warm (interglacial) and cool (glacial) conditions

The Change in climates has been driven by both the internal dynamics (tectonic plates/natural) of the Earth's systems and by external forces (humans) such as air circulation, water, etc.

Earths Climate:

'Weather' (short) and "Climate" (long) are two terms often used interchangeably but have very different meanings

Weather is measured by looking at changes in daily temp, precipitation, humidity, wind etc.

Climate is long term. It is measured from long term precipitation and temperature data, often expressed as monthly or seasonal averages.

"Climate is what you expect, weather is what you get"

Climate variability is the year-to-year variation in monthly or seasonal conditions

Climate change is the long term shift in an areas climate condition

Global temperature patterns:

Temperature at the surface of the Earth depend largely upon how much heat energy is received from the sun. At present, the average global surface temp is about 15 degrees C.

Areas that are closer to the equator are warmer than regions nearer the poles, due to the equatorial regions receiving more direct isolation

Greater cloud cover also reduces the amount of sunlight by reflecting isolation.

Equatorial regions are not the hottest parts of the world because of it.

Seasonal change will also influence temperature. The Southern Hemisphere from December to February, the Southern Hemisphere of the earth is tilted towards the sun, therefore it receives more isolation, raising surface areas, while it is opposite for the Northern Hemisphere.

Global precipitation patterns:

Precipitation is primarily located within regions of rising moist air and low pressure
In areas of high pressure, cool air is descending, eventually warming thus reducing condensation, resulting in clear skies

Near the equator in the tropics the highest rainfall is found. Annual rainfall totals in the tropics exceeds 2,500mm

Within polar regions precipitation is low due to a lack of evaporation. Therefore, the air is too cold to allow great amounts of moisture to form

Some parts of Antartica and the Arctic are as dry as the hottest desert. Climates of the Subtropics

Precipitation also decreases substantially within the interiors of major land masses, such as Australia, as the air dries and moves further away from its oceanic moisture source

Natural Systems that drive the Earth:

The Water Cycle

Step 1: Evaporation

Water at the surface turns into water vapours

Water absorbs heat energy from the sun and turns it into vapours

Through evaporation water moves from the hydrosphere to the atmosphere

Step 2: Condensation

As water vaporises into water vapour, it rises into the atmosphere

At high altitudes water vapour changes into very tiny particles of ice/ water droplets because the temp at high altitudes is low

These particles come close together (coagulate) from clouds and fogs in sky

Step 3: Sublimation

Water to water vapour without converting to liquid

Main source of water from sublimation are ice sheets from poles and mountains

Slow compared to evaporation

Step 4: Precipitation

Clouds pour down as precipitation to wind or temp change

Water droplets combine to make larger water droplets

Air cannot hold any more water it precipitates

Enters lithosphere

High alt temp is low and droplets loose heat energy and fall

Below 0 degrees C

Drizzle, sleet and hail

Step 5: Transpiration

Some water is absorbed by soil

Similar to evaporation where liquid water turns into vapour

Water is transported from soil by plant roots to stem and then leaves where it is then evaporated

Significant stage in Amazon where large mass of vegetation

Step 6: Runoff

Pours down (water form)

Water runs off over surface of earth

Snow melts = runoff

Displace soil and moves minerals

Runoff combines to form channels and then into lakes, seas and oceans

Water enters hydrosphere

Step 7: Infiltration

Some water that precipitates does not run off is instead absorbed or evaporated

Moves deep into soil (infiltration)

As water seeps down increases ground water

Pure water and is drinkable

Carbon Cycle

What is carbon?

- An element
- Basis of life on earth
- Found in rocks, oceans, atmosphere

Carbon cycle:

- Same atoms used repeatedly
- cycle between earth and atmosphere

Plant use carbon dioxide:

- Pull carbon from atmosphere and use it to make food (photosynthesis)
- Carbon becomes a part of the plant (stored food)

Animals eat plants:

- They take in Carbon and some becomes part of their own bodies

Plants and animals die:

- Bodies decomposing carbon atoms are returned to atmosphere
- Some are decamped fully and end up in deposits under ground (oil, coal, etc.)

Carbon slowly returns to atmosphere:

- Carbon in rocks and underground released slowly in atmosphere
- Many years

Carbon in Oceans:

- Additional stored in ocean
- Many animals use carbon for shells
- Animals die and carbon deposited at bottom of ocean
- Ocean contains earth's largest store of carbon

Human Impact:

- Fossil fuels release carbon slowly
- Burning anything releases carbon into atmosphere
- Increased carbon dioxide in atmosphere increases global warming
- Fewer plants = more CO₂ in atmosphere

What we need to do:

- Burn less fossil fuels
- Promote plant life, especially trees

Atmospheric Circulation:

Areas of high pressure and low pressure:

Poles =

- Cold air
- Air more dense
- Air more packed
- Less room for movement
- High pressure

Equator =

- Warm air
- Air less dense
- Air expands
- More room for movement
- Low pressure

At the equator:

Hot air rises but cools and drops creating a convection current

At poles:

- Air moves from high pressure to low
- Pole air never reaches equator because around 60 Degrees N air heats and rises again

Cells:

Cells between polar and equator cells are not driven by temp but movement of polar and equator cells

Cell Names:

- Polar cells (N,S)
- Ferrel Cells (between polar and equator cells)
- Hadley (Equator)

Atmospheric circulation:

Is the large-scale movement of air, it controls the distribution of thermal energy across the surface of the Earth.

Hadley Cells:

- Largest cells extending from the equator
- Referred to as the heat engine
- Exists as a direct consequence of surface temps
- Movement of heat energy away from the equator done by the Hadley cells

Polar Cells:

- Thermally induced like the Hadley Cell
- Coriolis effect (affects the cell via wind)
- By acting as a heat sink, the Polar Cell also balances the Hadley cell in the Earth's energy equation

Ferrel Cells:

- Located between the Hadley and Polar Cells
- Air is warmed at lower altitudes near earth surface
- The circulation within the Ferrel cell is interwoven with the sinking air from the Hadley cell joining with the return flow of air at high altitudes from the Polar cells. Moves in different direction from other cells.

Heat Budget and Greenhouse Effect:

What is it?

Radiation balance

Driving force of all other climate systems

Albedo: Reflection off of ice, snow, shiny surfaces

Radiation back (insolation):

Terrestrial (infrared) Long-wave radiation

Diff = insolation very high in energy = pass through atmosphere easily

LWR = Cannot easily pass through atmosphere.

Natural Greenhouse Effect:

15% terrestrial radiation absorbed

Essential to retain heat and keep the planet warm to sustain life

Earth will become 30 degrees C cooler than it is without it.

Interactions that influence Earth's climate:

The heat budget and natural greenhouse effect interacts with the Hydrological cycle to influence Earth's climate through the Creation of Earth's temperature and precipitation patterns

The heat budget and natural greenhouse effect interacts with atmospheric circulation to influence Earth's climate regions

The heat budget and natural greenhouse effect interacts with the carbon cycle to influence Earth's climate and temperature

The hydrological cycle interacts with atmospheric circulation to influence Earth's climate

The hydrological cycle interacts with the carbon cycle to influence Earth's climate

Causes of Climate Change:

Natural:

Earth's climate is driven by external influences various things can cause natural climate change

Solar Variations

Changes in the Earth's orbit

Plate tectonics

Volcanic Eruptions

Anthropogenic:

Greenhouse gases

Rice Cultivation

Livestock

Urban

Transport

Natural causes of climate change:

Solar variations -

Sun is the driving force for all life on earth

Light, Heat, Energy

The sun is approximately 4.6 billion years old, almost half way through its predicted life span

For every 1 billion years its brightness increases by 10%

Any changes to the amount of radiant energy emitted by the sun can affect and change our climate

Sunspot or solar cycle

Occurs every 11 yrs

Huge magnetic storms that occur on the sun's surface that cause its magnetic field to break, allowing extra radiation to leave the surface of the sun through solar storms

During a solar storm, extra radiant energy is released as coronal mass ejections (CME's) and solar flares

In the late 17th century, sunspot activity decreased dramatically 1650 to 1715

Maunder Minimum

Created a cooling effect due to the absence of solar activity

Partly responsible for the little ice age in Europe

Now greater number of sunspots occurring = increased temp

Due to the fluctuations Earth's global temp is being affected by about 25% of its current warming

Changes in Earth's Orbit -

Perihelion (closest point) with the sun

Aphelion (most distant point)

The north-south swing in apparent angle is the main source of the seasons on Earth

Orbital variation = slight variation in the Earth's orbit lead to changes in the distribution and abundance of sunlight

Milankovitch cycles - shape (Eccentricity), Axial tilt (obliquity), wobble (precession)

Results in 100,000 year ice age cycles over the last few million years

Shape (eccentricity)

Amount of "off centeredness"

Earth is approx. 3% closer in Jan

approx. 7% more insolation in Jan

When eccentricity is at its highest, the insolation reaching the earth is more than 20% stronger at Perihelion than Aphelion

The effects of the other natural foreign factors also help to mask or enhance the effects of orbital variations

Tilt (Obliquity)

Currently the tilt is 23.4 degrees and decreasing

A greater tilt allows for a stronger summer sun and a weaker winter sun

The warmer summers produced by increasing obliquity usually help to end the previous glaciation, leading to the end of the previous glaciation leading to an interglacial (warming) period

Wobble (Precession)

Every 26,000 years the Earth's axis wobbles through one full cycle of precession as it rotates on its axis

Shift the dates of perihelion and aphelion forward by about one day every 70 years
Solar intensity - greater in Northern Hemisphere warmer summers, colder winters; weaker in the southern hemisphere

Changes in Atmospheric Composition -

Greenhouse gases in the atmosphere are essential in retaining heat and making the Earth warm enough to support life

Stored in various sinks

Gradual but constant rearrangement of continents by tectonic plates movement influences the long-term evolution of the atmosphere

Carbon

stored in oceans, frozen tundra, vegetation and soils, limestone, hydrocarbon

Slight changes in environment (temp+moisture) can lead to changes in the uptake and/or loss of greenhouse gases

Higher temperature

more CO₂ emitted to the atmosphere due to feedback processes

Cooling reverses this feedback cycle

Plate tectonics -

Reposition continents

Shape oceans

Build and tear

Changes ratio of land to ocean

Large-scale ice sheets

Arrangement of continental landmasses at or near the poles

Will melt

Increased temp

Volcanic eruptions -

(sulphur dioxide and carbon dioxide)

Short-term cooling effect due to its reflective abilities of isolation

Reflect sunlight

prevents the sun's rays from heating the earth. It may take as long as seven years before the cooling influence of the volcanic aerosol disappears completely, resulting in a 'volcanic winter'

Mount Tambora - 1815 "Year without Summer"

Large amounts of sulphuric acid into atmosphere many plants and animals were pushed onto the brink of extinction.

Anthropogenic causes of climate change:

Greenhouse gases -

Carbon + methane released by burning of fossil fuels, clearing of forests and cement manufacturing

Increased terrestrial radiation trapped in atmosphere

Accelerated warming

Increased global temp

Industrial revolution - 1750

coal burning, steam engines released Greenhouse gases

IPCC, agricultural activities = make up 24% of greenhouse gas emissions

Rice Cultivation -

Arachala to break down - waste - by product = methane, roots and stems

Increased in LDC's like Indonesia where an increases population and rice is a main part of their diet and easy to grow

Increases greenhouse gases.

Livestock -

Australia= 66% of methane emissions
methane

Ruminant livestock

Digestion provasse

Enteric fermentation

Enters atmosphere and makes it thicker

Traps radiation

Impacts heat budget and enhances GHG effect

Urban -

Power plants / generators

Fossil fuels = electricity (heating, cooling, lighting, appliances)

Coal is the largest contributor of carbon dioxide emissions

from power generators

In Aus, energy double rate since 1990's

Transport

17 % Australia emissions

Road transport

900 million cars

Usually have more than 1 car

Transport emissions increased to 24%

Gases released - atmosphere - trapped radiation = increased global temp

Evidence of Climate Change: Geological

Ice Cores -

Bubbles trapped within the ice capture the gas concentration

Provides window into 800,000 years of past climates

Scientists obtain information by using a special drill that bores down into the ice, and removes a cylindrical tube called an ice core

eg. Vostok Ice Core

Joint Russian, U.S and French team in Antartica 1987

It reveals 8 previous glacial cycles

With each passing year, snow falls over the ice sheets and each layer of snow has a different texture and a different chemistry

Ice cores can tell scientists - temp, precipitation, atmospheric composition, volcanic activity and even wind patterns

Testing trapped air bubbles in the layers, the chemical composition of the snow itself and the temperature at the same time

All of the dust layers combined with chemical composition of the ice accumulates over time, allows scientists to date the age of the ice cores and therefore the climate conditions at the time

Land and Ocean Sediments -

Oceans and lake sediments consist of biological and other material that wash in from nearby land or that were produced by the lake/ocean itself

These materials are preserved as tiny fossils in the sediments and can be used to infer past climate

Scientists drill to obtain cores of sediments beneath the earth's surface
Shows sequence of change over time, past ocean temps, salinity levels, ice volume, river flow and millions of years before
Ammonia Baccari Foraminifera. (Fossil shells)
Surface of the North Sea Ocean floor sediments
Scientists can use the current environmental conditions to extrapolate past conditions where similar foram are found.

Fossil Pollination -

The walls of pollen grain, are made of a substance known as sporopollenin, which produces very tough and hard coat to protect the plants reproductive material during transit
When pollen grains are washed or blown into bodies of water their tough outer walls allows them to be preserved in sediment layers
Scientists can know:
Kind of plant growing at the time
Helps scientists make inferences about the past by looking at plant distribution
By analysing pollen from well-dated sediment cores, scientists can obtain record of changes in vegetation going back hundreds of thousands of years.
Schulzoopacampyoptera - Carboniferous period, providing evidence of the tropical and humid climate conditions at the time

Coral Reefs -

Are extremely sensitive to changes in climate conditions.
Affected by ocean warming causes bleaching when temp rises or falls
Also affected by pollen and runoff from land
Affected by changes in the pH of sea water, ocean acidification caused by more CO₂ dissolving in the ocean
Calcium carbonate skeletons form by extracting CO₂ from ocean water
Coral skeleton density varies with changes in water, temp, light and nutrient conditions
Season variations in density produce growth rings, similar to those found in trees

Evidence of Climate Change: Recent

Atmosphere -

Satellites
Last 3 decades excessively warmer
NASA 2016. Surface temp increased 0.8 in last 100 yrs

Ocean: -

Temp changes
Sea surface temp in Australia region increased by 0.9 since 1990
Drifting argo floats - 346 active from Australia
Temp, pressure, salinity from depth of the ocean
NASA MODIS satellites = global sea surface temp since 200
Ocean temp warmer, sea levels higher

Cryosphere -

Ice sheet balance
Comparing overflow and melt of snow fall accumulation
Changes in glacial elevation
Changes in Earths gravity field
Satellite

2 satellites. 2003 ICE-sat and Grace, vast improvement of measurement
 Greenland + Antarctic ice sheets losing mass, glaciers shrinking worldwide
 Greenland Ice loss was 34 Gt/yr now 215 Gt/yr

Interrelationship between Land Cover Change and Climate Change:

Changes in Surface Reflectivity:

Driven by sun

Albedo

When the flow of insolation is balanced by an equal flow of terrestrial radiation to space, the Earth is in radiative equilibrium

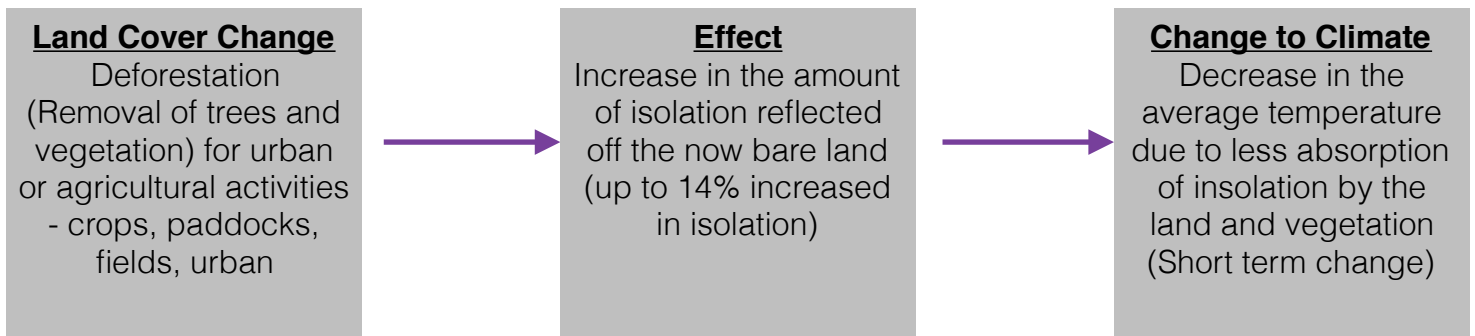
1. Cryosphere
2. The Lithosphere and Biosphere

The Cryosphere -

Bright snow and ice are very effective at reflecting insolation back into space

Changes in the polar regions can cause more warming across the entire planet through feedback effects

The reduction of ice and snow due to warmer temp instead the heat is absorbed by the sea



Negative feedback loop illustrating the interrelationship between land cover change, albedo and climate

The Lithosphere and Biosphere -

Deforestation and biomass burning releases CO2 into the atmosphere

impacts the carbon cycle and carbon sequestration and therefore climate

Vegetation that would normally store carbon is gone

Urban Heat islands

decreased albedo (hotter)

reduced atmospheric circulation

lesser extents, the waste heat from urban processes

Carbon Sequestration

Where carbon is removed from the atmosphere and stored as either a liquid or a solid

C.S reduces carbon in the atmosphere, this is a positive and can be used to reduce global warming and climate change

Two types of storage

1. Terrestrial storage - e.g wetland, water bottles, carbon sinks, soils, forests
2. Geological storage - stored in rocks deep in Earths surface eg. at power stations they remove carbon from materials and store it underground.

The Effects of Climate Change: Natural

Climate controls distribution of plant species and vegetation types

Change in climate - affect many non-plant species - habitat availability - global extinction

Australia and New Zealand have the second worst predicted rate of species lost due to; regions having mixed diverse species that occupy narrow habitat ranges

Species less able to migrate if current habitat becomes unsuitable

Vegetation -

Most plant species cannot shift their geographical ranges sufficiently fast enough to keep up with the estimated rate of change

Future vegetation is at risk and is expected to be high issued on observations that past natural global climate change

Increased temp - messes up crop growing - stress plants

Slow growth - Increased fire risk - pink beetle able to kill more trees. Used to occur in a period of 2wks it is now from May to October

Coastal systems + Coral reefs -

Increased ocean temps

Decreased oxygen levels

Increased ocean acidification

Coral bleaching

Sea level rise = beaches gone, estuaries gone, coral reefs gone, wetlands gone

Increased sea level 1.7 mm per year over past 100 yrs

Southward migration of birds

Mangroves destroyed/water flows over them, no protection

Great Barrier Reef

Increased sea level

Increase ocean temp

Increased salinity levels

Bleaching + acidification

next 50 years 95% of GBR dead

Ice Sheets and Glaciers -

According to NASA and DAT, less ice accumulation, greater ice melt

Mountain glaciers are disappearing eg. Argentina and Rocky Mountains

Glaciers have retreated eg. Argentina/Brazil

Rocky's 1meter per year

The Effect of Climate Change: Anthropogenic

Agriculture -

Increased temp

Increased - less effect than natural as humans can help maintain and control its effects on agriculture

Increased temp - changes crop season and growing season. Availability of water + nutrients/nitrogen

Increased in-arable land temperature

Decreased in Arable tropic

Urban Settlement -

Flooding

Increased temp - albedo effect

Increased weather events = increased damage

DHAKA

lives in slums

Increased temp

Increased flooding

Increased thousands dead/have no homes as they are destroyed

Islands 'sinking' e.g Papa New Guinea

Industry -

Most are able to adapt as long as climate change is gradual

Agro industries -

precipitation decreases

extreme weather events increase impact

LDC heavily effected as main source of income

Hydroelectric production

precipitation will change

water availability especially for glacial run-off

Higher Temperature - cooling increase = heating decrease

more energy for cooling

peak demand for electricity

Increased cost

Increased mining activities

Fossil fuels

Sea level rise

protected industry/infrastructure/industrial plants

Coastal protection = market opportunity for construction industry

Tourism

Shorter skiing season

reduction in snow cover

increased sea level. Beach resorts

Depth Study 2: Investigation land cover change and Management.

By altering landscapes for agriculture, industry, mining, forestry and settlement, this creates a number of negative impacts

Land cover change and its associated impacts isn't the only challenge that humans must address. To overcome these challenges, humans will need to put in place strategies to mitigate, restore, rehabilitate and manage land cover change and its impacts as well as climate change and biodiversity loss.

Approaches to land cover Restoration and Rehabilitation

Restoration = bringing something back to original state

Rehabilitation = preparing/process to bring back

Restoration and rehabilitation approaches can include removal of introduced plant and animal species, removal of any contaminants in the soil or hydrological features and revegetation of the area.

Restoration and Rehabilitation - Beelias Wetlands (located in Fremantle/Cockburn area)

Due to urban and agricultural activities the wetlands became severely degraded
Since the removal of these land uses, restoration and rehabilitation strategies have occurred

Each year 5,000 to 10,000 endemic native plants are established, including both understory and overstory

Annual watering program from seedlings

Removal of introduced pests and weeds, including the melaleuca nesophila and European rabbit

Ongoing maintenance and checks of regrowth

5.5 hectares successfully restored since 1985

Rehabilitation of Point Walter Reserve (posh part of Perth near river)

Degraded due to erosion and anthropogenic land cover changes including changes in vegetation land cover to non native species

Substantial erosion over last 10 years - boating

The reserve is an important habitat for fauna within the swan river ecosystem

The rehabilitation strategies implemented include the removal of non endemic trees, placement of gabon cages and limestone boulders

Reforestation projects - Rwanda (L.D.C Africa)

Pressure to use land for agriculture is very high

Leads to high levels of erosion once the natural vegetation has been cleared

Top soil is washed off down the steep slopes and terracing is needed to reduce soil loss and sedimentation of rivers and streams

Succession by anthropogenic biomes has also resulted in declining biodiversity

Reforestation projects are under way to encourage the planting of eucalyptus and other exotic trees

Continual restoration and Rehabilitation has meant a gain of over 50% more forest cover between 1990 and 2011

Unsustainable as they are not enduring that social, economic and environmental improvements and being considered

Mine Site Restoration and Rehabilitation (most relevant)

When mining companies move into an area to explore and extract mineral resources, land cover is removed.

Open cut = removes top soil and rock layers. Causes large areas to be stripped of vegetation

In Western Australia mining companies are legally obliged to restore and rehabilitate the natural environment

Western Australia Mining Act (1978) and the Environmental Protection ACT (1986) of Australia which is government by the Department of Parks and Wildlife

Mine Site Restoration and Rehabilitation (Specific)

Alcoa:

Land scaring: mines are filled in

Pre-ripping: Soil on the ground is made loose

Soil return: Soil extracted from the site is put back

Final contour ripping and speeding: seeds are added to soil.

Mounds are Created to minimise soil erosion

Flora is reintroduced (natural/ already there)

Recalcitrant planting: cuttings and things are re-sprout are planted including grasses and sedges.

Fertilising: Fertiliser is released once in August to promote growth of new seedlings

Ongoing Monitoring and Management: Rechecked/monitored over time to see if anything needs foxing or rehabilitating again.

Mitigation Future Land Cover Change:

Mitigation refers to all the efforts and actions put in place to reduce or even alleviate completely the severity and effects of a phenomena being studied through targeting the causes

Acts and Regulations for future land cover change -

- Conservation and Land Management act 1984
- Wildlife Conservation Act 1950
- Environment protection and biodiversity conservation Act 1986

Mitigation in the South-West -

Forest management plan 2014 - 2023. Covers a total area of 2.5 million hectares of land extending from Lancelin to Denmark - rural areas.

1. Use of reserves
2. Restricting future land cover change
3. Eliminating introduced pests and diseases

62% is either existing or proposed reserve area

A reserve is simply a network of protected areas; national parks, state forests, conservation parks, natural (formal) reserves and informal reserves

The aim of the Forest Management Plan is to continue to increase the amount of area placed within reserves by further investigating and placing areas of biological importance into reserves in order to prevent future land cover change. As of 2001, legislation was brought into stopping logging.

Other areas of biological importance, including key habitat areas for endangered animals

Limitation and restriction on the amount of land cover for urban and rural activities is also occurring in the southwest. Forest is limited to an average annual cut of 483,000 cubic meters of Jarrah and Karri

By eliminating introduced pests, weed species and disease, such as {Phytophthora dieback, this also aims to mitigate future land cover change in the south-west.

Mitigation and preservation in Metropolitan Perth -

Proposed Green Growth Plan are also found within the Perth and Peel Plan @3.5 million

Urban growth boundaries have been put in place to preserve areas and therefore restrict forest land cover change

The Bush Forever program also a strategic plan within Directions 2031 for the conservation and mitigation of natural land cover change. Within the Perth Metropolitan area. Urban filling = reduced urban sprawl (build up). 880 hectares cleared for urban development

Mitigation and preservation in South America -

Strategies come about through Joint collaboration of volunteer wildlife organisations, the communities and governments of South American countries

The Brazilian Soy Moratorium is a mitigation strategy put in place to reduce the amount of future forest land cover change from agricultural activities such as soy. Prevents major traders from selling soy that may be linked to deforestation in the Amazon. Established 2006, it monitors 73 districts responsible for 98% of soy produced in Amazon biome. Due to strategy, only 4.6% of all deforestation that occurred between 2007 to 2013 were caused by soy plantations

Global Climate Change - Mitigation

Global emission targets -

Australia 26-28% relative to 2005, reducing emissions to levels consistent with limiting global warming to less than 2 degrees C about pre-industrial levels.

Governments co-operatively work towards mitigating the impacts of detrimental climate change through organisations such as the United Nations Framework Convention on Climate Change (UNFCCC). By increasing international awareness the imperative to act locally, nationally and globally will contribute towards active mitigation strategies aimed at reducing the effects of climate change being more widespread.

Reforestation -

Process of restoring vegetation and flora to a bare area of land which was previously vegetated

Greenhouse gas emissions of carbon dioxide (CO₂) are reduced significantly as the plants and trees, being carbon sinks, absorb and store CO₂ from the atmosphere.

Can reduce carbon in the atmosphere by 25% by 2050

The Eden Project replanting lost forest areas in Ethiopia, Madagascar, Haiti and Nepal

15,998,000 trees have been replanted in Ethiopia since 2008 and 3 large nurseries have been built to ensure the continual growth of seedlings for future reforestation

Also training over 500 teachers with the skills needed to start small scale nurseries and to grow seedlings in their school, with these skills and education being incorporated into the curriculum

Renewable Energy -

Renewable energy relates to energy which is derived from resources that are essentially inexhaustible, they are replenished rapidly by natural processes

Includes wind power, solar power, wave/tidal power, geothermal power, hydropower and biomass

Create electricity without producing greenhouse gas emissions mitigation strategy used local and global levels.

Renewable energy target. Australia's is for at least 33,000 gigawatt-hour (GWh) electricity to come from renewable energy sources. Australia like many countries around the world uses a wider range of renewable energy sources.

Wind Power -

A wind turbine is constructed with three rotors or blades which are connected to the large tower frame of the turbine

In Australia, wind power is the fastest growing renewable energy source. Supplying 4.9% of Australia's overall electricity in 2015. There is a lot of room for improvement

Western Australia has 7 wind farms (Albany wind farm)
Globally 3.7% of electricity is produced from wind energy
In 2015 wind power avoided over 637 million tones of CO2 emissions globally

United states, Denmark, China, Brazil and the United Kingdom have decreased their amount of greenhouse gas emissions over the past decades through the use of wind power.

In America the amount of energy produced from wind turbine is 26 times more than that was produced in 2001.

China has had the largest growth in wind power installation with over 92,000 wind turbines

In Denmark 42% of electricity consumption is being generated from wind energy. Danish gov helps for 100% renewable energy sources by 2050.

Hydropower -

Also known as hydroelectricity. is renewable energy that is obtained when moving water is channeled through water turbines
Hydroelectricity used in around 160 countries

Australia has over 120 operating hydroelectric power stations. However due to declining rainfall and water shortages, the amount of operating power plants will shrink. Expected by 2020 to drop by roughly 3.5%

Carbon Capture and Storage (CCS) -

Works by capturing CO2 from large point sources, such as fossil fuel power plant, which is transported and deposited into a storage site. Reduces amount of anthropogenic CO2 that is emitted into atmosphere.

Before the fuel is burned (pre-combustion)

After the fuel is burned (post-combustion)

During the fuel in more oxygen and storing all gases produced as a result (oxyfuel). By taking oil. CO2 goes into the ground

The Gorgon Carbon Dioxide. Injection project

Set to become the largest CCS program in the world when it becomes operational next year.

Will capture and store CO2 produced from the gas processing facility, with the capacity to store 3.4 to 4 million tones of CO2 per annum.

Anticipated to reduce annual greenhouse gas emissions from the Gorgon Project by 40%

Carbon Trading Scheme

is a cap and trade strategy, that is put in place at both local and global scales to reduce anthropogenic greenhouse gas emissions

It then distributes emissions allowances or credits to each business

This process is intended to mitigate carbon emissions by providing a financial incentive to businesses to reduce their emissions

Longest and Largest running international scheme is the European Union Emission and trading Scheme 2005.

Agriculture climate - Smart initiative

Minimum tillage, soil sequestration, revegetation and reforestation and changing diets of ruminant livestock

Ruminant Livestock (Dietary Changes)

Strategy reduces methane that is produced in cow's rumen from digestive processor enteric fermentation, as well as reducing nitrous oxide and methane produced in the animal's waste.

By increasing the tannin oil and fat content, methane emissions are reduced as supplements suppress the methane - making microorganism methanogen archaea.

The microbes involved in digesting carbohydrate - rich diets are different to that of digesting hay and grass and will result in lower levels of methane produced

Improving Public Transport -

In Australia 17% of its overall greenhouse gas emissions comes from traffic .

By improving and expanding public transport infrastructure, more commuters will be encourage to use these networks instead of private vehicles which will lead to a reduction in greenhouse gas emissions

Rail expansions occurring along the Midland line to Bellevue adding 150 new rail cars to existing fleet of 116 trains to ensure efficient service along lines

Global Climate Change - Adaptation

Desalination -

Supply of fresh water in places that have little to no rainfall

Currently 44% of worlds pop live in areas with high water stress

Due to climate change North west of Aus. getting more rainfall while in southwest it is getting drier

Groundwater from the Jandakot and Gnangara water mounds provide approx. 43% of Perth's water supply because not enough surface water.

Two-large scale reverse osmosis seawater desalination plants have been constructed to meet the increasing demand for water. Currently over 17,000 desalination plants worldwide

Desalination is the process of removing salt and other materials from sea water or other water sources to make it suitable for drinking or irrigation

Positives and Negatives of Desalination plants:

“quick fix”

Does not lead to any future depletion of current dams and aquifers as sea water is plentiful

Operate and provide excellent source of water regardless of rainfall

However, plants require large amounts of energy to operate (run by combustion fuels)

Heavy concentrated brine pumped back into the ocean

Very expensive to build and increase water costs. Increased to 50%

Dams and Reservoirs -

North of WA, in particular Kununurra, extremely high rainfall in wet season and this is expected to increase due to climate change

Allowed for effective use of irrigation channels running from the Ord River into Agricultural land

However, during dry season, rising temps and heat waves has meant that the river flow is reduced to a series of waterholes and does not provide the necessary water to the agricultural areas.

To adapt, dams and reservoirs were built along Ord River.

Genetically Modified Crops (GM) -

Adjust farming practices to the new conditions. decreasing rainfall and increasing temp

Include; Resistant to pests, insects, diseases; heat tolerant and drought tolerant; salt tolerant; study to withstand weather extremes

Current GM crops = wheat, rice, canola, squash etc.

In Africa they have developed drought resistant maize, boosts harvest by 10 + 35%

In Asia, drought tolerant rice

In Aus, drought tolerant species of wheat and barley are being trialled. Not much water, faster maturing, more resistant to disease.

Changing Breeds -

Changing breed of livestock

certain breeds will be better suited to the new climate conditions

Ankole Watusi - breed of cattle that can survive on limited quantities of food + water

Graham Cattle - breed that possess a greater ability to withstand heat

Maasai Zebu cattle - another heat tolerant breed.

Cross breeding intolerant breeds with those from Africa is another adaptive strategy

The Brazilian super cow, a cross bred Brazilian and Indian cow, can produce more offspring, is drought tolerant and has greater milk production.

Land Reclamation and Protective Barriers -

Island communities often rely on groundwater supplies that are vulnerable to salt water inundation, makes water undrinkable and unsuitable for irrigation.

In order to adapt to rising sea level and its effects, land reclamation strategies and protective barriers have been put in place.

Maldivian's - more land is found along road verges, home gardens, and by reclaiming land

Land reclamation on Maldives has involved adding sand to the Island to increase their height above sea level through dredging sand from the ocean floor.

Polders- used in low lying countries. Are areas of low-lying land that have been reclaimed from a body of water and is protected by dykes (walls)

Revegetation of forest areas along coastal belts has occurred in order to construct a natural barrier against sea level rise.

Addressing Impacts of Land Cover Change:

South west area, a number of programs have been designed and implemented, locally and regionally, in order to address the impacts that are occurring within the Jarrah Forest region.

These include the Oil Mallee Program, Karakamia conservation area, Silviculture and Western Shield.

Agroforestry -

Land management system where trees and shrubs are grown around or among crops and pasture land

It is in one part of the Department of Parks and Wildlife's revegetation strategy in order to address the impacts of loss of habitat and biodiversity. as well as soil erosion and degradation, particularly that of salinity in the Wheatbelt. Within this region local native plants are being planted to assist in conservation of existing biodiversity

Oil Mallee Project:

Focusing on the use of the Mallee eucalyptus to support biodiversity, water and soil conservation. The Eucalyptus mallee was chosen as it grows productively in low rainfall areas, does not require fencing from livestock, will assist in managing water better, will minimise the potential for new wood weeds and will reduce the impact of salinity on soil and wetlands

Currently there are over 900 farms involved in the project. Seen reduction in salinity and change in their landscape from the native plants, protection that mallees provide from wind erosion of the soil .

Unit 4:

Places and Challenges:

50% of worlds pop now live in urban areas
21st century = 'urban century'

Level of Urbanisation -

Refers to proportion or percentage, of people living in urban areas or settlements at a point in time (local or national or global)

Processes of Urbanisation -

Refers to the reasons for the increase in the level of urbanisation that may occur in a region or country.

Urban Growth -

Increase in the number of people living in urban places

The rate of pop growth and urbanisation especially since the commencement of the Industrial Revolution in the 1700s. Has profound impacts in terms of those who are urban and/or rural-based.

The issue of urbanisation sustainability is particularly challenging within as Australian contexts where the vast majority (80%) of people live within the state and territory capital city regions

Rural and Urban Places:

Used both in a general and specific sense.

General terms - 'town', 'country'

Specially is used to distinguish between two types of settlements based on the occupation types of the majority of the inhabitants of the settlement

Urban populations tend to be significantly higher in more developed regions and high incomer regions

A number of major regions have levels of URBANISATION well above the world average

Europe (73.4%), Latin America (79.5%), North America (81.5%), Australia/New Zealand (90%)

Rural populations tend to be dominated in regions such as Africa (60%) and lesser extent in Asia (52.5%)

There are many instances within cities and towns where people are engaged, albeit on a small-scale basis, in farming or agricultural practices.

Perth City Farm in East Perth is an example of such activity very close to the centre of Perth. Increased Backyard farming = Allotment

Urban and Rural - statistical and fundamental definitions

Demographic indicators such as population size, density and diversity as well as land use

There is no universally accepted measure as different countries use different techniques and measurements to define when a place continues a city

In Australia, the Australian Bureau of Statistics (ABS) uses a population range approach to define what is urban and rural

Statistical * Urban area is anywhere with a pop exceeding 1,000ppl.

2 types of urban area

1. Major urban areas with a pop of 100,000 or more
2. Other urban areas with a pop between 1,000 - 99,000ppl

Hence, anywhere less than 1,000 is considered rural

Functional definitions -

Places or settlements where the majority of inhabitants are directly employed in secondary, tertiary and quaternary industry occupations or functions are deemed to be URBAN

Places or settlements where the major or inhabitants are directly employed where the majority of inhabits are directly employed in primary industry occupants or functions are deemed to be RURAL

Primary - Number of African countries (farming + agriculture)

Secondary - China (manufacturing)

Tertiary - America + Australia (services = office workers)

Quaternary - Australia + America (Intellectual service + research)

Economic and Environmental Interdependence of Urban and Rural Places

Population living in rural places, typically farmers, would create enough demand for non-agricultural goods and services that the establishment of urban places of various sizes to supply these goods and services would take place.

Geographers often refer to the flows of goods, services, people, capital and information between regions and places when studying their interaction and interdependence

Economic Interdependence -

Agricultural products to be consumed locally and exported to both national and international markets is a significant interaction between rural and urban places

Food: Are produced in rural places and transported to urban places for further processing and distribution. In Australia 40% of all farm produce is consumed domestically and 60% exported overseas. Rural bands, the gazetting of towns and establishment of road and rail networks facilitate the expansion of agricultural activities into rural areas.

Raw Materials: Supplied from rural places to urban places include those from mining activities and forestry. Mining makes jobs both in rural and urban areas. It has been estimated that between 25 to 40% of all office space in the Perth CBD is linked to mining and exploration industries

Energy Production: For urban places predominantly occurs in rural areas. The Collie town in Western Australia are examples of centres of coal based energy production.

Jobs: Mostly in urban areas as well as increased education, social, sporting and cultural opportunities (Rural Urban Shift)

Capitol and profits: Accumulated in urban places are used to provide infrastructure, investments and facilities in rural places eg. Food and Fibre research, support for education. The 'Royalties for Regions' program in Western Australia has been the state government set aside millions of \$ to develop rural based infrastructure and facilities.

Environmental Interdependence -

Short term - The desire to experience opportunities for an escape, reflection, recreation and reconnection with nature in pristine areas of wilderness, beside the ocean or in wide spaces is common, or take a risk.

Long term - Urban dwellers may seek to relocate due to perceived or real benefits in terms of lifestyle, affordability, space and safety.

The vastness and remoteness of rural areas often results in the flow of wastes from urban to rural places.

Rural places are often viewed as suitable dumping grounds for urban wastes. Air pollution and acid rain threaten both cultural and physical environments.

Urban places rely on natural places to manage the environment effectively to ensure the needs of the growing urban population are met.

Clean air and water, flood and drought mitigation, soils and soil fertility, pollution mitigation etc are all largely dependent on how well rural areas are managed.

However both do affect each other.

Factors that have contributed to the spatial distribution of urban and rural places in Australia.

The distribution of urban and rural places in Australia.

16 cities in Australia accounted for 75% of the total Australian pop (23.5 million) in 2015

90% of Australia's pop live within 80km from the coast. The southeast and extreme south west coastal areas contain the most urban places.

Despite have a coastal settlement pattern, large areas of the central-northern, mid west, north west and northern coastlines from Broome to Cairns are virtually devoid of settlements and population.

Urban rural distribution

1.5 Aus live in Sydney. Most live on coast 60% Melbourne and Sydney, 80% Adelaide and Brisbane.

Historical Factors -

Australia was not established as a single nation, rather 6 different colonies
Each settlement was located on the coast and on a river, inlet or natural harbour
Government controls for building of infrastructure were centred in these settlements and have become a hub of economic activity and employment

Main ports - importing and exporting

Need to be self-sufficient in food production meant that eventually exploration to find rural areas suitable was encouraged and new urban settlements were developed

Economic Factors -

Capital cities and ports:

Economic inertia where change has been resisted (eg. moving Fremantle port to Kwinana)

More transported = import and exports. The presence of the facilities and Services mentioned has meant industry industry and commerce have always been attracted to the larger, coastal urban places

Urban multiplier effect = continued establishment of new businesses and associated employment

All centred their operations in largest urban centres

Mineral Discoveries:

The discovery of gold and other mineral and energy commodities has continuously shaped the nature and location of urban and rural places across Australia.

Kalgoorlie Boulder. Worlds largest continually operating Gold Ore body is the only remaining urban centre.

Increased population - minimising primary reason

Jobs (fly in/fly out)

Agriculture:

Residents are employed in non-primary industry forms of employment

Fibre production such as wheat and cereal grains gave rise to small rural series

Farm Amalgamation leads to *economies of scale.* Join or come together.

No one left to inherit farms. As young go to city instead.

The overall trend is that many small centres are getting smaller and the fewer big entries are getting bigger.

Transport and railways positioned at main settlement allowing it to grow.

Decentralisation and Settlement Schemes:

Decentralisation: moving services and people and companies out of the city

1. Returned soldier settlement - meaningful work and gives agricultural land
2. Irrigation schemes = win win scheme pop is steady - crop growth = industry at Ord river with Dam.

Environmental Factors -

First settlers = Sydney

Climate:

Agricultural regions

The higher the productivity of the land the more services in the area.

The soaring summer temperatures, cold winter temp inland and general lack of reliable rainfall, have resulted in the presence of few settlements not directly associated with mining and exploration.

Hydrology:

Both for agriculture purposes and as a water supply.

Flat coastal plains along coastlines resulted in extensive, low diversity nature of Australia; large urban places = Low density Urban due to flat land.

Provides barriers (Great Dividing Range)

Soils:

Nature of Soils

Fertile alluvial soils around more mountainous regions along east coast and southeast corner due to rainfall and runoff

Less fertile soil = less urban and rural settlement.

West contains sandy clay soil = less settlement

Cultural and Social Factors -

Rural Urban Drift = rural to urban

Young adults from to more urban/city places education

Job opportunities

Cultural opportunities/social opportunities

Retirees often move to rural places and smaller coastal urban places

Mandurah. South of Perth, now has a pop of over 83,000

Challenges Facing Rural and Remote Places in Australia

Sustainable development: Development that meets the needs of the present generation without compromising the ability for future generations to meet their own needs

Social, economic and environmental = 'triple bottom line'

Population loss -

result of a combination of inter-related factors driving increased urbanisation

1. Post War industrialisation and economic growth
2. Rural - urban migration and to a lesser extent
3. Mass international migration (boosting urban places)

Young people moving to urban areas

Loss of employment in remote locations due to amalgamation and corporatisation of small farms. Falling demands for goods and services

Isolation and remoteness - poor provisions of services, housing and transport -

Areas usually have lower population and are therefore not economically viable

Health provisions, to far away including ambulances

Royal Flying Doctors Service

Availability of consumer goods and services eg. fresh food

Lack of available and affordable housing. Lack of investment and labour for new infrastructure

Retail and sales in short supply

Fly in/Fly out work patterns, economic restructuring and changing employment patterns -

Economic restructuring: Significant and during changes to the nature and structure of the economy

Fly in/Fly out = do not provide many services in the town or community. Large economic leakage (loss of local businesses as spending declined)

Take salary back to where they live

Loose sense of identity (Town)

Jobs lost

Social Inclusions and Exclusion -

Social inclusion:

Person has the opportunity to-participate in society through employment and access to services; conned with family, friends and the local community; deal with personal crisis and be heard

Social Exclusion:

Do not have these opportunities can lead to mental health issues.

Concentration of Socially Vulnerable Populations -

Social Vulnerability: People who are unable to withstand repeated adverse impacts from multiple stresses from life events to which they are exposed

Higher mental health issues including depression and suicides

Young Indigenous up to 24 years old are 5.2x more likely to die due to intentional self harm.

Indigenous children counted for almost half of the deaths between ages of 10 and 17 between 2004-2012.

Resource Degradation and Water Supplies -

Land use deteriorates the quality of the biological environment on which it is located or surrounded

Soil Degradation (60% of Aus land use is agriculture) 80% of this activity is livestock grazing - arid and semi arid locations

Drylands salinity as a response to land. Clearing

As the water table rises, dissolved salts were brought to the surface

Loss of both native flora and fauna of habitats

WA wheatbelt loosing about a football field of land to salinity every hour.

Land Use Conflict -

Conflict between different stakeholders

eg. Mining and the Indigenous and proposal to undertake coal mining in the Margret River Region

Risk to groundwater and threat of viticulture

Stakeholder groups include Conservation Council of WA actively campaigned the proposal

Declining Political Influence -

Voice of the people living in areas is not as powerful an influence

Over 100 years ago roughly 40% of ppl sired in rural areas. Now 10%

The Federal electorate of Durack is the second largest electorate in the world

Just one member of parliament represents this vast region of Australia and all of its diverse needs.

Depth Study Two [a]: Investigating New York Megacity.

Mega City: Defined as areas of continuous urban development in excess of 10 million people, the modern megacity solved in the west.

In 2014, the United Nations reported that 54% of Worlds pop lived in urban areas. 28 megacities 2014. Hold 12% of world pop.

New York City was the first city to reach a pop of 10 million in middle of 20th century

The city became an industrial powerhouse in the 19th century

The rapid growth of the city at the time created urban problems including slums, inadequate sanitation, water shortages and pollution

City attracted immigrants from across the world setting in place its diverse ethnic population. More recent challenges include the restricting the city's economy, congestion, social inequality, housing and climate change

Introducing New York As A Megacity

approx. 20 million ppl

Was once the world's largest urban agglomeration (cities joining together)

Is a world city. (influence over global activities)

New York remains the world capital for commerce and finance. Also extends into culture, as a hub of both fashion and entertainment.

Hosting the headquarters of the United Nations

New York's Site

The deep-water harbour (now a global maritHub)

There was freshwater in the nearby Hudson River and small creeks as well as raw materials for building supplies

Presence of islands was advantageous but reduced the amount of available space to develop the city. This has led to increased urban densities and Manhattan is reflective of this.

Brownstone, a type of sandstone was readily available from quarries located in New Jersey and connection

Undulating coastal plain (Atlantic coastal plains)

Generally flat land exists across the city.

Highest point being Todt Hill on Staten Island at 124.9m above sea level

New York's Situation

Located in the north east of the United States

Longitude and latitude = Latitude: 40 degrees 42' 52" N and Longitude: 74 degrees 0' 23" W,

Approx. 350km SW of Boston and 430km NE of Washington

Triangular trade between Europe, North America and Africa

Situated in the extreme southeastern corner of NW state bordering New Jersey

Five boroughs - separately various waterways

Mass transit network of Subway and rail coverages on Manhattan, as does an extensive web of expressways and parkways

Series of major bridges and tunnels connect boroughs. eg. Long Island Expressway

Urban Morphology of New York City

External Morphology -

Multi cellular

Covers some 790km squared

Hudson and East Rivers and Manhattan and Staten Island; the waterway accessibility of Manhattan island was advantageous to the early settlers who relied heavily upon shipping transportation

Expansion began once bridge and tunnels overcame the physical barrier

Atlantic coastline restricts the city's external development to east and mountain ranges including Catskills in the west.

Internal Morphology -

New York's transportation networks influenced both external and internal morphology

Central Business District:

Multi nuclei

Includes financial district and Midtown

The Financial district was the site of the original Dutch settlement due to its harbour access

Intense land use competition

Area is an aggregation of commerce and finance

Midtown shares high levels of accessibility

Inner Mixed Zone:

Comprises of older inner neighbourhoods that fringe the CBD

Transitional zone - semi intensive mixture of land uses. Dissimilar functions eg. warehouses, factories, restaurants

In NYC mixed neighbourhoods surrounding the Financial District and Midtown make up the IMZ

In Manhattan IMZ, includes former Industrial areas of SOHO, Tribeca and Chelsea, many residential areas in lower Manhattan were one slums

Residential Zone:

Most dominant in terms of spatial extent

Contains wide variety of dwellings of different ages, style and quality

Manhattan Island residential regions begin around Central Park

moving into Harlem and the Bronx. Residential density is very high

Redevelopment has been going on since the 1950s, to clear former slums and tighten buildings in Manhattan. Attraction of suburbs

includes affordable cheaper land, less congestion and larger blocks

Special Purpose Zones:

Headquarters of the United Nations in Turtle Bay, Manhattan zone that is 'one of a kind'

Manhattan's Central Park and Brooklyn's Prospect Park significant in size

Airports + JFK (John F. Kennedy) La Guardia

Amusement area found at Cooney Island

Sporting venues - closely linked to public transport. Billie Jean King

Tennis Centre = US Open. Yankees Stadium in the Bronx

New York City Demographics Characteristics

Large and ethnically diverse pop.

A cultural melting point

African American, West Indians, Chinese, German, Italian, Irish and Russians

Over 200 languages spoken in the City

2014 U.S Census data pop over 8 million

10,000 people per km²

Age and Gender -

By 2030 median age will increase by 4 years. 85 years will increase by 12%

All pop. groups below 50 will decline

Females will continue to outlive male counterparts

Manhattan island highest non family and single occupant household

Outer boroughs have more families and Children under 18.

Non family households
Manhattan: 59%
Brooklyn: 33.7%
Bronx: 32%

Singe Occupant Households
Manhattan: 48%
Brooklyn: 27.8%
Bronx: 27%

Apartment living in high rise buildings
Further from city centre = suburbia similar to Aus but far higher pop. density

Socio-economics:

Ranges from poverty to considerate wealth
District zones appear inner = rich commute via public transport and for food.
Second (outer boroughs) poor commute via public transport and 3rd (Westchester). The rich drive.
Anomalies do exist and Manhattan good example where low income salaries occur. China Town and Washington heights. both have a high number of poorer quality multi unit buildings
Many of these buildings were developed in the 1950s' known as brownstone to rid U.S of slums (known as super block, super cheap and high density)
Five counties in the U.S account for 5.1 % of the total residency population of America]
Manhattan has the highest per capita income in the U.S. \$100,000
Wealthiest 20 % of pop earn 35 to 40 times the amount of the poorest 20%
The divide between socio economic groups within New York City continues to Grow

Cultural Distributions:

Predictions are that the total pop of NYC will increase as will the ethnic distributions
Since 17th century, immigration fuelled NYC's pop growth. Coming for Work, to Flee etc. Most came from Germany, Ireland, Italy and Russia
Now 63 % Hispanic, African American and Asian, the city population by 2030 will comprise almost 80% of these groups as well as other Europeans
Total pop by 2030 predicted to be 9 to 9.5 million and will be diverse like never before
Despite being 'melting point' of different nationalities, the ethnic characteristics of NYC's neighbourhoods have not dramatically changed.
Staten Island
Pop is smaller, older and wealthier
5.5 % of city's total pop, within 14.1 % aged 65 or over
Average household income = \$72,500, over double that of the Bronx.
Pop is predominantly white - least diverse borough
Isolation may have made it undesirable for newly arrived immigrants
Fewer cultural enclaves
Public transport is limited.
Ove time improvements in transport tech has made it more accessible to the rest of the city. Ferries and bridges
Quite and relaxed urban environment - more recently exurbanites seeking this and affordable housing may find Staten Island as their home
Recognised for its beaches and open spaces

Nature, Scope and Cause of Congestion

Traffic congestion is when the movement of vehicles along road networks begins to slow, increasing trip time and vehicle queuing
Problems often associated with arterial roads
Further increases in population with place considerable strain on the existing infrastructure

Causes and Implications of Congestion

Traffic moves less than 20km per hour during peak periods in virtually every street in lower Manhattan and Midtown
Less than 5% of Manhattans population drives to work.
If left unaddressed, by 2030 every subway line approaching Manhattan will reach capacity.
Some of NYC express ways were built through dense urban areas where there simply no rooms for new lanes eg. Cross Bronx express decrease 18km/h during bottleneck
Cutting to 2 driving lanes and 3 for bus lane during peak
The pop is said to increase by 1.5 million people, from 1.6 million to 3.1 million due to commuting workers with tourists, visitors and shoppers
A lack of public transport or poor public transport will cause problems most notably for outer boroughs eg. Queens
Removal of freight train railway in Manhattan meant island relies on trucking for bulk item. This and dense grid system with traffic lights = heavy congestion
Traffic congestion creates social, environmental and economic issues for communities

- Environmentally = increased population from increased car usage
 - In NYC traffic = 25% emissions
 - More car parks = increased urban heat islands
- Economically = Time spent in traffic non productive and costly = \$6 billion lost time and productivity, consume more fuel.
- Social = fifty minutes per day commuting. In New York over 1 hr. Excessive noise pollution and respiratory illnesses

Urban Redevelopment - Addressing and Restricting

New Yorks Economy -

Areas that once contained manufacturing are now being rezoned and redeveloped (mix use function) that greatly improve amenity and sustainability

Urban redevelopment is reigniting economic growth as well as increasing the social and environmental appeal of areas that were once blighted rust belts
Case Study = High Line

Bicycle Networks: Addressing Congestion within NYC

Looking at alternative forms of transportation - improve liveability

Public transit, cycling or pressuring government for change

Globally bicycling initiatives that address congestion are gaining momentum

Starting in 1990 - Greenway Plan

Since 2006 commuting numbers have doubled to around 20,000 as some 360km of new bike lanes developed within boroughs

Social Benefits -

Health benefits are significant. Accessible to socio-economic groups unlike congestion it does not discriminate against the poor. Less Stress

Economic Benefits -

Cost is minimal compared to other modes of transport. Cheaper to build more and longer bike paths and less time. Indirect benefits from less congestion and decreases emissions. Lots real estate values

Environmental Benefits -

Far less road space taken up

Open spaces and housing. Does not contribute to climate change emissions = light on the environment

Limitations -

Storage for bikes. Becoming issue as more people are riding. Changing roads to suite bikers, parking high when compared to other schemes.

Bike sharing scheme = 10,000 bikes are available around the city. 500 bike station spread around 50 neighbourhoods

Users receive a code which they type into keypad to release a bike

Attracts tourists and locals alike

Three lanes: Pedestrian footpath, bike lane and then car park lane.

Planning Strategy Implemented (Sustainability)

Sustainability: “Forms of progress that meets the needs of the present without compromising the ability of future generations to meet their needs”

Sustainable urban planning: the development of policies and practices that aim to reduce the impacts of urban growth on society and the environment whilst achieving economic development

New York City approached sustainable planning in the aftermath of 9/11 (2001) which raised serious questions about the city’s future. The global financial crisis (GFC) in 2008 further tested the city’s administration

In 2007, the former mayor of New York Michael Bloomberg introduced a 25yr strategic planning scheme to sustainably expand the city. Titled PlaNYC. Central vision was for a ‘Greener and Greater’ New York City

PlaNYC: Scheme focused on 127 initiatives

- infrastructure spending

- zoning changes to 40 per cent of the city

- water front development

- reducing green house gas emissions by 16 per cent

Involved government stakeholders from 25 agencies as well as engaging private groups

In 2015, Mayor Bill de Blasio announced a new planning scheme entitled OneNYC. The vision, ‘a strong and just city’, focuses on growth, equity, sustainability and resilience.

Included 200 new initiatives

OneNYC does build on many of the original commitments. Such as reducing the city’s carbon emissions by 80 per cent by 2050.

New plan has been recognised as comprehensive plan to reduce urban poverty within the city by increasing both the minimum wage and the number of preventative health programs

OneNYC attempts to address a number of challenges, including rapidly growing population, rising inequality, raging infrastructure and climate change

OneNYC includes initiatives to make the city more resilient in the face of predicted rises in sea level and increased storm activity

OneNYC directly addresses the key themes of Sustainability

- socially

 - plan aims to lift 800,000 people out of poverty or near poverty by 2025 and reduce permanent mortality

- economically

 - the city hopes to house 4.9 million jobs within the boroughs by 2040 and reduce the annual economic losses of climate related events

- environmentally

 - an ongoing goal is to have the best air quality of any U.S city and sending zero waste to landfill

- politically

 - aims to ensure that all new yorkers will have access to resources that promote civic engagement through providing high quality, conveniently located, community-based city resources

Highlights of OneNYC

- Energy consumption and Generation

 - NYC is committed to reducing emissions by 80 per cent by 2050

 - city plans to decentralise energy production as a means of mitigating against carbon emissions

 - target will be met through a combination of energy efficiency

 - measures and micro generation renewable energy system

 - NYC plans to decentralise the generation of electricity and recover surplus heat for buildings and hot water

Mass Transit

56 per cent of its residents travel to work via public transportation

The average New Yorker can reach 1.4 million jobs using public transit in 45 minutes

To improve growth and equality, the city hopes to increase the transit access to jobs by 25 per cent - 200,000 jobs within a 45 minute transit zone

The 7-line is one example of recent extension to the subway system. Starting at Flushing in Queens to the east, the 7 line has recently been expanded further west to Manhattan Island to incorporate the Hudson Yard Redevelopment

Housing

The desirability of New York as a place to live and work has and will continue to place pressure on the cost of housing

By 2040, the population of the boroughs is set to reach 9 million and at least 3.7 million extra housing units will be needed

'Housing New York' is an ambitious program to create affordable housing units over the next decade

High Line and Liveability

In order to preserve employment and develop new opportunities areas that once contained manufacturing are now being rezoned and redeveloped

Such areas are now being converted into mix-use functions that greatly improve amenity and sustainability

redeveloped areas becoming increasingly sought after

High Line facts:

Most of the 19th and 20th centuries, the lower West Side of Manhattan was a vibrant trading area. Tenth Avenue became notorious as freight trains killed many pedestrians

Men on horseback would ride in front of approaching trains with red flags to warn people "West Side Cowboys"

Plans made in 1920's to elevate tracks as part of an economic stimulus project in the wake of the Great Depression

The high line was designed as a suspended industrial railway passing through roughly 3 km of Manhattan's west side

Saved many lives, reduced congestion and increasing the agglomeration links between manufacturing industries including the National Biscuits Company.

Beginning in 1934, trains ran along the elevated tracks day and night, cutting through factory buildings, speeding the delivery of goods such as meat and furniture

The rise of interstate trucking, global air travel and container shipping reduced New York's railway freight traffic

In 1980, the last train ran across the High Line

Part from the Southern side were removed in 1991

While trees and bushes grew surrounding buildings became riddled with blight and economic activity stagnated

August 1999, 2 locals formed a group and campaign to save the high line from demolition "Friends of the High Line"

They won support from Mayor Michael Bloomberg to protect and redevelop the line into walkway trails and parklands

Has transformed the West Side of Manhattan and has been seen as a model of redevelopment in other cities around the world.

Addressing Sustainability and Liveability:

Social:

Since redevelopment, crime has been reduced

The Passive surveillance can be attributed to this; with greater pedestrian activity on the streets there are 'more eyes'

Cuts through a number of major art galleries with some of the highest concentrations of contemporary art in the U.S example Whitney Museum of Contemporary Art.

People can easily socialise, exercise and relax in a stimulating natural setting

Small parts and recreational areas are also found along the High Line helping to address the City's PlaNYC goal of having people living within a 10 minute walk to an open space

Economic:

Recycling of the railway into a urban park has encouraged real estate development in the adjacent neighbourhoods

Project has helped with something of a revitalisation in the neighbourhoods

In the first 3 years after construction, more than 30 projects were planned or under construction nearby

Multi-function and employs a variety of people

Function:

Internet companies

cafes

restaurants

meat processors

The aggregation of technology firms is increasing local economic productivity

Googles New York headquarters is around the Corner in Chelsea

From cost perspective, city committed \$112.2 million to the \$150 million project. Friends of the High Line raised the remainder

The increase in development and land values has provided a good return for the city's investment as higher land taxes can be recouped both now and into the future

The cost of residential property has doubled within the immediate vicinity of the park

Environmental:

High Line's landscape acts a green roof, reducing storm water runoff by up to 80% and reducing the impact of the Urban Heat Island effect

Tree plantings create shade and a habitat for insects and birds

The high line is part of a migratory corridor along the Hudson River for 300 species of birds including raptors

The plant selection focuses on the native, drought-tolerant and low maintenance species that reduce the need for pesticides and chemical fertilisers

Lighting systems use energy - efficient LED lights to safely illuminate the pathways and planting without overhead glare or wasting energy

All material used for the high line landscape has been assessed from a lifecycle perspective - durability and overall life span

Planks of steel, wood and other materials were selected based on life - cycle costs, so to reduce the need to replace and dispose of the materials after a short time

Limitations:

Lack of affordable housing in the area as the popularity of the High Line has now driven up housing and rental costs.

The Hudson Yard Redevelopment at top of High Line includes 12 million feet squared of mix-use development provides more housing however little will be affordable

The park often closes due to weather particularly snowfall during winter

As land competition increases, uncompetitive industries that remain in the immediate area will be under great pressure to relocate - will impact vibrancy of area

Possibly creating a sanitised social environment with less economic and employment diversity

Locals complain that the area has become somewhat of a over crowded tourist theme park and not exactly relaxing

Definitions:

Environment: Everything around them, living (biotic) and non-living (abiotic)

Ecosystem: Community of living organism and their interactions with the non-living features of an environment

Food Chains and Food Webs: Illustrate the flow of energy through ecosystems

Affluence: Is having a great deal of money and wealth

Capitalism: Personal Economic freedom including private ownership of land and enterprises

Socialism: Government can operate institutions which provide goods and services

Monoculture: Where one type of crop is produced in an anthropogenic biome

Watershed areas: Area of land where water drains into rivers and dams

Eutrophication: Excess nutrient and fertiliser from agricultural activities enters the watershed area, polluting the water by causing algal blooms

Climate Variability: Year-to-Year variation in monthly or seasonal conditions

Climate Change: Long-term shift in an area's climate condition

Coriolis Affect: When winds are deflected from a straight path to a curvature nature due to the rotation of the earth.

Restoration: Bringing something back to original state

Rehabilitation: Repairing/process to bring back

Mitigation: Refers to all the efforts and actions put in place to reduce or even alleviate completing the severity and effects of a phenomena being studied through targeting the causes

Preservation strategies: The most common mitigation approach for future land cover change

Adaptation: When humans make alterations or adjustments in response to a changed environment

Desalination: Is the process of removing salt and other materials from sea water or other water sources to make it suitable for drinking or irrigation

Genetic Modification: Is when individual genes with specific desirable traits are transferred from one organism to another

Urban Sprawl: Refers to the outward spread of an urban area

Location: In Australian urban environment such as the capital cities

Influence on Land use: resulted in new housing developments stretching further and further from city centre. This process leads to a number of associated problems including the provisions of infrastructure and services to these new developments, which is extremely expensive

Urban: Tends to occur in a low density fashion resulting in single story, detached homes built on her outer edges of the city

Rural: Encroachment into other land uses usually natural vegetation or rural land use and a heavy dependence on private vehicles as public transport it is often not well established.

Invasion and Succession: Invasion occurs when one land use function enters another land use zone.

Location: Occurs in transitional zones such as within the inner mixed zone and rural urban fringe

Influence on Land Use: Has led to a number of issues within the Urban and rural places including urban blight as the uncertainty of future invasion prevents the necessary upkeep of properties. Often leading to buildings taking on a run down appearance and lowering the land value of the surrounding area.

Renewal: Refers to larger scale redevelopment projects, which can take place within an urban or rural location.

Location: Usually occurs in areas that are heavily blighted or rundown with the aim of rejuvenate the area.

Influence on Land Use: the renewal of previous industrial areas to mixed use complexes and or renewal of slums into new residential estates

Inertia: Is a process that acts to limit change within an urban or rural area.

Location: It occurs when a land use function has retained its location despite the original benefits which attracted it to a location

Influence on Land Use: This resistance to change and resistance to change locations, is usually due to high relocation costs

Urban and Rural: In urban and rural environments older buildings often those that had been heritage listed remain in their original end up being surrounded by other land use functions such as an older church now being surrounded by high rise buildings (City Centre)

Agglomeration: The process refers to the grouping together, or clustering of similar land use functions within an urban or rural place.

Location: Land use functions group together due to the derived benefits of using shared infrastructure as well as sharing services

Urban and rural: large industrial centres emerge comprising of industrial based companies in one location, often spate from main residential areas. The same occurs in rural locations, where service centres cater for the needs of the farming communities or where agricultural based businesses locate on the edge of small country towns.

Changing demographic trends of Australia's population. Refer to both urban and rural:

It can be seen that Australia has been a predominately urbanised nation over the last 100 years or so. After federation (1911) after WWII (1947) in 1911, the urban distribution of the population was at 43%, this then decreased to 25% in 1951 and in 1976 it was 14%, then to decrease to 11% in 2001. Urban population distribution in 1911 was at 58% then increased to 75% in 1951 and then steadily increased to 90% in 2011.