



<http://www.fao.org/sustainability/frameworks-approaches/en/>

## Sustainable Biomes: An introduction

**Lorraine Chaffer, President GTA NSW & ACT**

### Unpack the syllabus

- Begin with the CONTENT FOCUS as an overview of the topic.
- Link the statements to SYLLABUS DOT POINTS (Must be covered)
- Use the DASH POINTS for teaching ideas
- Go back to the content focus for direction
- Check that activities will allow students to:
  - meet SYLLABUS OUTCOMES
  - answer KEY INQUIRY QUESTIONS

The INTENT is for students to develop their knowledge and understanding about;

- the nature of biomes and their productivity
- the link between biomes and agricultural production
- the consequences of the use of biomes for agricultural production
- challenges to food production
- the issues of sustainability and food security and strategies to address these.

### Content focus

Students examine the physical characteristics and productivity of biomes. Students examine the correlation between the world's climatic zones and spatial distributions of biomes and their capacity to support food and non-food agricultural production. Students analyse the impact humans have on biomes in an effort to produce food and increase agricultural yields. They examine population trends and projections from Australia and across the world and forecast future food supply-and-demand issues. Challenges to food production are explored and management strategies investigated.

### Outcomes

#### Geographical Knowledge and Understanding

**GE5-1** explains the diverse features and characteristics of a range of places and environments

**GE5-2** explains processes and influences that form and transform places and environments

**GE5-3** analyses the effect of interactions and connections between people, places and environments

**GE5-5** assesses management strategies for places and environments for their sustainability

#### Geographical Inquiry Skills

**GE5-7** acquires and processes geographical information by selecting and using appropriate and relevant geographical tools for inquiry

**GE5-8** communicates geographical information to a range of audiences using a variety of strategies

## SUSTAINABLE BIOMES:

### Linking the content focus, content, outcomes & key inquiry questions

CONTENT FOCUS	ESSENTIAL CONTENT	CONTENT IDEAS
Students:	DOT POINTS OUTCOMES <i>Key inquiry questions *Syllabus</i> <i>Key inquiry questions *Non-syllabus</i>	Use the DASH POINTS to build your topic content OR Use your own expertise to structure your program
Examine the physical characteristics and productivity of biomes.  Examine the correlation between the world's climatic zones and spatial distributions of biomes and their capacity to support food and non-food agricultural production.	Students investigate the distribution and physical characteristics of biomes.  <i>What are the main characteristics that differentiate the world's biomes?</i>  <i>How does primary productivity vary between biomes?</i>  <i>Challenge question: Should biome maps include anthropogenic biomes?</i>  <b>GE5-1, GE5-7, GE5-8</b>	Examine the spatial distribution of biomes.  Explain the impact of the climate, soils and vegetation of a biome on its productivity.  Identify biomes used to produce food, industrial materials and fibres.
Explore challenges to food production.  <i>* It is important to understand the factors that influence food production to understand the challenges.</i>	Investigate environmental, economic and technological factors that influence agricultural yields in Australia and across the world.  <i>Why are some parts of the world able to produce higher yields from agricultural activities than others?</i>  Investigate environmental challenges to food production for Australia and other areas of the world.  <i>What challenges limit the potential of agriculture to increase food production?</i>  <b>GE5-2, GE5-7, GE5-8</b>	Examine environmental factors that affect food production eg temperature, water availability, soil, topography.  Discuss economic factors that affect food production eg global trade and commercialisation  Explain the role of technology in food production eg innovations and advancements in farming practices.  The impact of water scarcity, pollution, land degradation and competing land uses on food production.  Assess the extent to which climate change can affect the capacity of countries to increase food production.
Analyse the impact humans have on biomes in an effort to produce food and increase agricultural yields.  Investigate management strategies.	Investigate the human alteration of biomes to produce food, industrial materials and fibres and the environmental effects of these alterations.  <i>How do people use and alter biomes for agricultural production?</i>  <i>What are the consequences of biome alteration?</i>  <b>GE5-3, GE5-5, GE5-7, GE5-8</b>	Examine human alterations to the physical characteristics of biomes eg vegetation removal, agriculture, land terracing, irrigation, soil fertility.  Assess environmental impacts of human alterations to biomes eg habitat and biodiversity, loss, water pollution, salinity  Discussion successful sustainability strategies that minimise environmental impacts.
Examine population trends and projections from Australia and across the world and forecast future food supply-and-demand issues.	Investigate the capacity of the world's biomes to achieve sustainable food security for Australia and the world.  <i>Can the world's biomes sustainably feed the world's population?</i>  <i>What strategies can be used to increase global food security?</i>  <i>Challenge Question: Can all food production systems be more sustainable?</i>  <b>GE5-1, GE5-2, GE5-3, GE5-5, GE5-7, GE5-8</b>	Assess the capacity of biomes to produce food into the future.  Analyse population projections to predict future demand for food.  Examine sustainable practices used to achieve food security.  Discussion of the potential for Australia to contribute to global food security.

## KEY TOPIC CONCEPTS

**Biomes** – major terrestrial vegetation communities eg a tropical forest, a temperate grassland or a desert. Biomes represent globally significant patterns of life across the biosphere.

**Anthropogenic Biomes** – also known as “*anthromes*” or “*human biomes*”, describe the terrestrial biosphere in its contemporary, human-altered form as a result of sustained direct human interaction. The terrestrial biosphere made the critical transition from mostly wild to mostly anthropogenic, passing the 50% mark early in the 20th century.

**Climatic zones** – areas of the Earth that have similar temperatures. The major zones are hot, temperate and polar and are generally demarcated by lines of latitude.

**Spatial distribution** – The location and arrangement of particular phenomena or activities across the surface of the Earth.

**Biome productivity** – refers to primary productivity or the amount of biomass (living plant / organic material) produced through photosynthesis (expressed in units of energy or in units of dry organic matter). Primary productivity varies within and between biomes and over time. The least productive biomes are limited by climate extremes like deserts and polar tundra. The most productive ecosystems typically have high temperatures, plenty of water and lots of available soil nitrogen. The most productive biomes generally have the best capacity to produce food.

<https://www.geographyalltheway.com/myp/myp-biomes/productive-biomes.htm>

**Agricultural production** – using the land to produce food, non-food and industrial products for example:

- when biomes are harvested for their natural resources
- when biomes are altered by ploughing, terracing, irrigation, draining for agriculture
- different foods are produced from different biomes eg forests or grasslands

**Agricultural yields** – the agricultural output per hectare of land eg crop yields, milk yields.

**Food production capacity** – the ability of the land to produce arable (plant) or pastoral (animal) products for consumption varies spatially and over time (temporally).

**Industrial produced materials from agriculture** – eg rubber, opium, biofuel.

**Fibres produced from agriculture** eg cotton, wool, hemp, flax

**Technological innovations** – new technologies that change farming practices and increase farm yields eg. precision agriculture, drones, remote sensing

**Water scarcity** – the lack of sufficient available water resources to meet demand.

**Environmental impacts** – changes in environmental quality eg air and water pollution, noise, access to open space, traffic volumes, the visual effects of buildings and roads OR environmental functions – the processes that supports human life and activities.

**Land degradation** – reduction in the health of land resources through human actions eg salinity, accelerated soil erosion, loss of biodiversity and habitats.

**Competing land uses** – when biomes are used for non-agricultural purposes such as urban development, infrastructure, mining, resource exploitation eg gas.

**Climate change** – a long-term change in regional or global climate patterns eg annual precipitation, frequency of weather events.

**Population projection** – a picture of what the future population may look like, based on knowledge of the past and current fertility, mortality and migration patterns and trends.

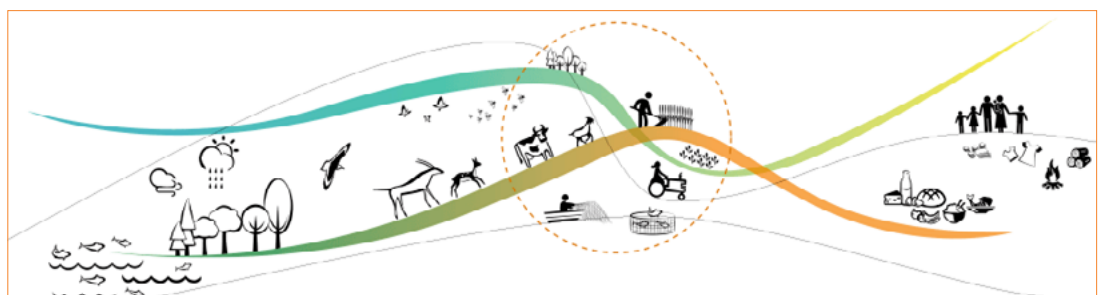
**Population trends** – any measurable change in the characteristics of a population over time that can include changes in population size, distribution and growth.

**Food security** – when all people at all times have physical and economic access to sufficient, safe, nutritious food to maintain healthy and active lives.

**Geographical challenges** – Issues and problems arising from interactions between people, places and environments that threaten sustainability eg biodiversity loss, food insecurity.

**Sustainable practices to achieve food security** – practices that prevent, minimise or repair the negative environmental consequences of food production while achieving food security.

Source: <http://www.fao.org/sustainability/background/principle-5/en/>



## A SCAFFOLD FOR TEACHING SUSTAINABLE BIOMES: INQUIRY APPROACH

### BIOMES

*What are the main characteristics that differentiate the world's biomes?*

- Earth's climate zones & Earth's biomes
- Australia's climate zones and Australian biomes
- Influence of climate on spatial distribution of biomes (Including latitude, altitude and continentality)
- Investigative study: Compare TWO biomes, characteristics (location, climate, biodiversity)
- Biomes and ecosystems – a matter of scale and purpose.

*How does primary productivity vary between biomes?*

- Primary productivity of biomes
- Reasons for differences in primary productivity using TWO examples (climate, soils, biodiversity)
- Primary productivity and agricultural production – what is the link?

*Challenge question: Should biome maps include anthropogenic biomes?*

- Human transformation of biomes
- MAP: Global anthromes

**Conclusion (Content focus):** What is the correlation between the world's climatic zones, the spatial distribution of biomes and their capacity to support food and non-food agricultural production?

**In this edition:**

- *Sustainable biomes crossword and answers* (David Proctor)

### HUMAN ALTERATIONS TO BIOMES

*How do people use and alter biomes for agricultural production?*

- Biomes used to produce agricultural products (food, fibre and industrial)
- Human alterations to the physical characteristics of biomes eg vegetation removal, land terracing, ploughing, irrigation, soil fertility

*What are the consequences of biome alteration?*

- Environmental impacts of human alterations to biomes eg habitat and biodiversity loss, water pollution, salinity, soil erosion, soil infertility
- Sustainability strategies that minimise environmental impacts eg wildlife corridors, tree planning and wind breaks, no till farming,

contour ploughing, fencing waterways, recycling wastes, irrigation practices, Aboriginal farmers

- Investigative study: The importance of bees to future food production.

**Conclusion (Content focus):** What impact do humans have on biomes in an effort to produce food and increase agricultural yields and how can these be minimised?

**In this edition:**

- *Using Dark Emu in the Geography classroom* (Simone Barlow and Ashlee Horyniak)

### AGRICULTURAL PRODUCTION

*Why are some parts of the world able to higher yields from agricultural activities than others?*

- Environmental factors that affect agricultural production eg temperature, water availability, soil, topography (relief, gradient), natural hazards
- Economic factors that affect agricultural production eg global trade, cash cropping, competing landuses
- Technology in agricultural production eg innovations and advancements in farming practices including precision agriculture, use of digital and spatial technologies, robotics
- Investigative study: A recent media report.

*What challenges limit the capacity of agriculture to increase food production?*

- Challenges to maintain or increase food production water scarcity, pollution, land degradation and competing land uses on food production
- Climate change and the capacity of countries to increase food production.

**Conclusion (Content focus):** What impact do humans have on biomes in an effort to produce food and increase agricultural yields and how can these be minimised?

**In this edition:**

- *Urban sprawl is threatening Sydney's foodbowl* (The Conversation)
- *Bees, biodiversity and food security* (Lorraine Chaffer)
- *Farming on thin ice* (The Crawford Fund)
- *Planning for climate extremes in global farming* (Pursuit, Melbourne University)



## ACHIEVING FOOD SECURITY

*Can the world's biomes sustainably feed the world's population?*

- Population projections and the future demand for food
- Food security / economic and physical access to food
- Investigative study: one food security issue eg food waste, food deserts, food miles, food supply chains

*What strategies can be used to increase global food security?*

- Sustainable farming practices to increase productivity while environmental impacts e.g. organic farming, permaculture, regenerative agriculture, urban agriculture, 'under glass' farming
- Sustainable Development Goals
- Individual and community actions eg food waste, farmers markets
- Discussion of the potential for Australia to contribute to global food security

*Challenge Question: Can all agricultural systems be more sustainable?*

- Sustainable farming practices at a range of scales
  - smallholders, to large scale industrial farms, Indigenous farming
- The potential for Australia to contribute to global food security

**Conclusion (Content focus):** What are the challenges to achieving global food security and environmental sustainability in agriculture?

**In this edition:**

- *Sustainable water and energy management in Australia's farming landscapes* (WJ Hurditch)
- *Dehydration and rehydration of the Australian Landscape* (Campbell Wilson)
- *Opening young eyes to careers in agriculture* (Lynne Strong, Art4Agriculture)

## FARM STUDY (FIELDWORK)

*Has farming created a human biome (anthrome) or a modified natural biome on this farm?*

*To what extent does this farm illustrate sustainable farming practices while maximising its agricultural yield?*

- Spatial patterns and characteristics of the farm
- Environmental factors affecting food production
- What would / could have been the original biome in this location?
- Changes to the biome made to produce food
- Strategies to increase productivity / yield including the use of technology
- Food supply chain (inputs and outputs from the farm / markets)
- Strategies to achieve sustainability and minimise environmental impacts

**Conclusion (Content focus):** What role can farmers play in achieving sustainable food production in Australia?



Technology and agriculture. Source: <https://www.borgenmagazine.com/new-technologies-agriculture/>

## RESOURCES

### These sites have fully developed programs with excellent resources

- Cool Australia: Love food, Love bees/ Food security – <https://www.coolaustralia.org/unit/love-food-love-bees-food-security-sustainability-year-9-10/>
- Sustainable biomes Weebly – <http://lumengeo.weebly.com/sustainable-biomes.html>
- Weebly: Biomes and food – <https://biomesandfood.weebly.com/resources.html>
- Food for thought (Murdoch University) – <https://sites.google.com/site/edn113year9geog/home>
- Webquest – <https://www.createwebquest.com/sustainable-biomes-year-9-geography>

### Special purpose

- LIFE SKILLS: Activity Booklets – <https://www.tes.com/teaching-resource/4-x-life-skills-activity-booklets-for-sustainable-biomes-year-9-nsw-australian-geography-curriculum-11577859>
- Lorraine's Scoop.it Sustainable Biomes (NSW) – <https://www.scoop.it/topic/year-9-biomes-and-food-security>

### Biomes

- Blue planet biomes – [http://www.blueplanetbiomes.org/world\\_biomes.htm](http://www.blueplanetbiomes.org/world_biomes.htm)
- Introduction to biomes (visual stimulus) – [https://www.youtube.com/watch?time\\_continue=5&v=hly0ZlyPPDg](https://www.youtube.com/watch?time_continue=5&v=hly0ZlyPPDg)
- World Biomes: An introduction to climate – <https://youtu.be/ZouWWVyz9v8>
- World Biomes: An introduction to climate – <https://youtu.be/ZouWWVyz9v8>
- Biomes and ecosystems – <https://www.bbc.com/bitesize/guides/zh2p34j/revision/1>
- Human influence on ecology Mapped: Introducing the concept of anthromes – <https://youtu.be/sTUOHMkGa0Q?list=PL652CEE41BA54D6CA>
- Anthropogenic biomes INTERACTIVE MAP – <http://ecotope.org/anthromes/v1/guide/>

### Biomes, sustainability and food production

- Oxfam: Which biomes are able to produce food – <https://www.oxfam.org.au/get-involved/how-schools-can-get-involved/classroom-resources/food-4-thought-2/food-4-thought-geography/worksheet-2-which-biomes-are-able-to-produce-food/>

- Where the world's food comes from – <https://www.dailymail.co.uk/sciencetech/article-3643363/How-far-food-travelled-Interactive-map-shows-world-s-food-comes-from.html>
- Sustainability: what does it mean? – [https://youtu.be/\\_5r4loXPx8](https://youtu.be/_5r4loXPx8)
- Biomes and sustainability – <https://smithbiome.weebly.com/sustainability.html>
- Climate smart agriculture – <https://www.youtube.com/watch?v=IUdNMsVDIZ0>
- Soil degradation and how to correct it – <https://www.youtube.com/watch?v=DM4AhycQzv0>
- Lets talk about soil – <https://www.youtube.com/watch?v=invUp0SX49g>
- Soils for food security – [https://www.youtube.com/watch?v=AY9YVwJZDvw&list=PL\\_OCfTZ7-XBAjq6lXO5ej6\\_JHRF1iQIM2&index=8](https://www.youtube.com/watch?v=AY9YVwJZDvw&list=PL_OCfTZ7-XBAjq6lXO5ej6_JHRF1iQIM2&index=8)

### Sustainable agriculture

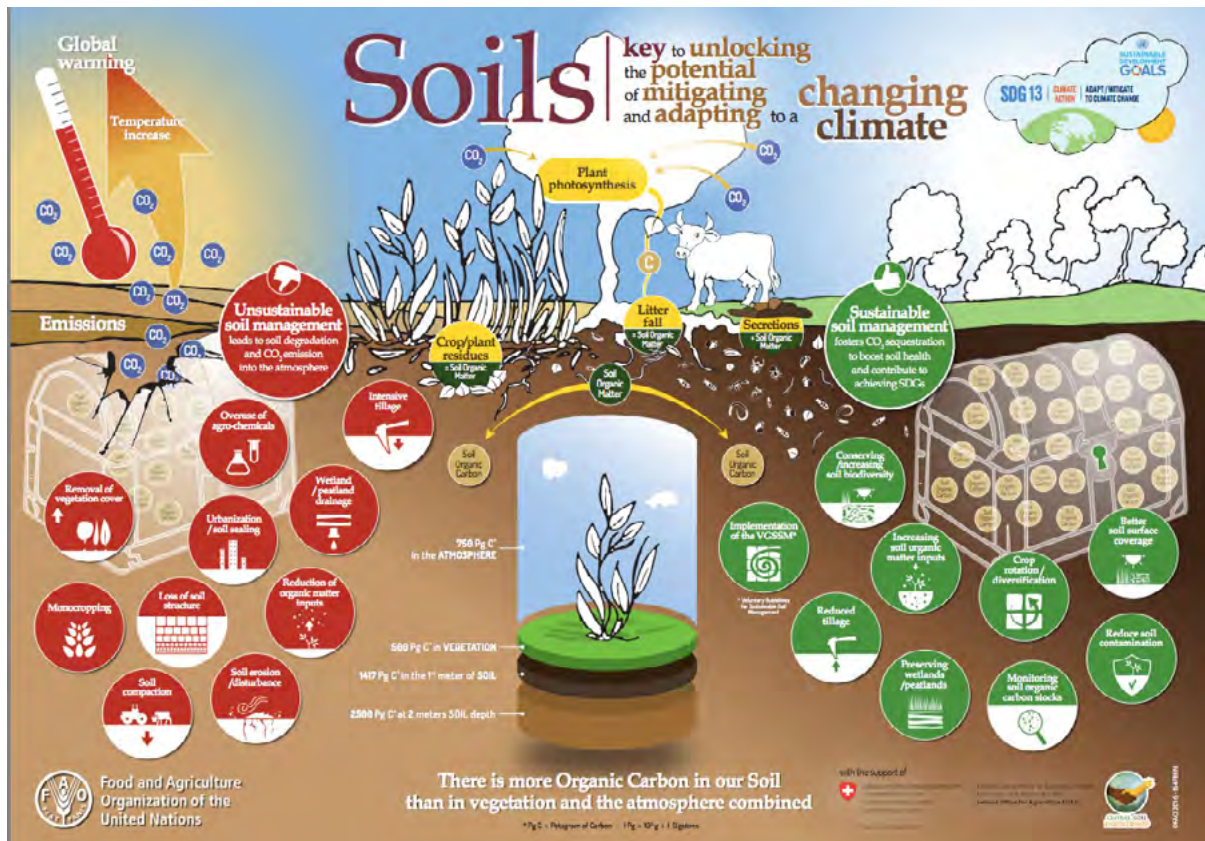
- FAO Sustainable Food and Agriculture – <http://www.fao.org/sustainability/frameworks-approaches/en/>
- A new beginning for the Australian Landscape – <https://www.youtube.com/watch?v=tj4nwzscuZ0>
- Innovative cattle stations in Australia – <https://www.youtube.com/watch?v=pdfSOUfd4fo>
- Regenerating the land. Cattle in the Kimberleys – <https://www.youtube.com/watch?v=9Y-N0iydQgQ>
- Greener horizons: Western Australian farmers share their experience with tree crops – <https://www.youtube.com/watch?v=yBaLLJ-UH8k>
- The future of farming and agriculture – <https://www.youtube.com/watch?v=yBaLLJ-UH8k>
- Will tech take over the farm? – <https://www.youtube.com/watch?v=JPvjucZPZLM>
- Farms of the future – <https://www.youtube.com/watch?v=Xg27iMXwdV0>
- Farm of the future – [https://www.youtube.com/watch?v=-\\_tvJtUHNmU](https://www.youtube.com/watch?v=-_tvJtUHNmU)
- How Australian Farmers are adapting to climate change – <https://www.youtube.com/watch?v=fRDYnH29F34>
- The Mulloon Institute (Landscape regeneration / natural Sequence Farming) – <https://themullooninstitute.org/projects/#mclrp-section>
- Hope springs: Australian Story – <https://iview.abc.net.au/show/australian-story/series/2018/video/NC1802Q029S00>



# BIOMES

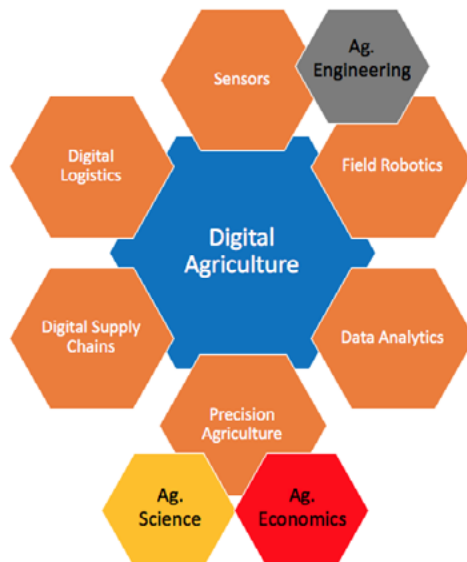
## Food security

- Food security – <https://www.youtube.com/watch?v=VCYeLuURxRM&t=8s>
- Food security – [https://www.youtube.com/watch?v=yHyqj65Rq\\_A](https://www.youtube.com/watch?v=yHyqj65Rq_A)
- Food security, an inescapable challenge for the future – <https://www.youtube.com/watch?v=Mxj2APMuuJw>
- Does Australia have food security? – <https://www.youtube.com/watch?v=VWp5OAdqzxY>
- Food availability in remote indigenous communities – <https://www.youtube.com/watch?v=deaO2n6pjEk>
- Feeding 9 billion No 5 – Local food systems – [https://www.youtube.com/watch?v=35mOyg7\\_A8g](https://www.youtube.com/watch?v=35mOyg7_A8g)
- Feeding 9 billion No 6 – Climate change & food security – <https://www.youtube.com/watch?v=cYq2elstFWQ>
- Feeding 9 billion No 3 – What policies can make our food system more sustainable? – <https://www.youtube.com/watch?v=YN0bCJ1M6p8>



Above: Sustainable farming maintains soil services.  
Source: FAO via Twitter

## WHAT COMPRISES DIGITAL AGRICULTURE?



Left: Sustainability and Innovation panel, GTANSW & ACT Annual Conference 2019 – Innovation in Agriculture. Source: PPT Presentation Professor Alex McBratney, Sydney University

Watch this presentation: <https://vimeo.com/334802051/1df2d8d6a0>