



Year 8

Stage 4



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Curriculum focus

The resources in the Geography Teacher Manual help teachers and students explore how environmental changes challenge and influence sustainable farm management practices in agriculture. Students explore the Virtual Video Excursion/s for one or more industries and use this information to explore water security and soil management and the significance of geographical locations and landforms.

How to use this Teacher Manual

The Geography Teacher Manual consists of lesson plans and supplementary activities about several agricultural industries in Australia. There are facts about Australian agriculture for your use on page 4, 6, 13, 17, 24 and 32.

First, start with the Springboard virtual video excursions on page 5.

Then, move on to the products or industries within this manual that match your learning aims or interests.

Additional research sources, facts and vocabulary are included within each industry section. They can be used in class discussion or provided to students for their projects.

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Themes and topics:

- Animal welfare
- Biodiversity
- Communications
- Community
- Drought & natural disasters
- Economics
- Employment
- Environment
- Ethics
- Food miles
- Food security
- Food waste & recycling
- Innovation
- Marketing
- Nutrition
- Pests & diseases
- Profitability
- Seasonality
- Soil & pasture management
- Sustainability
- Technology
- Traceability
- Waste management
- Water security



Australian Curriculum Links

All Industries

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Cross-curriculum priorities

Aboriginal and Torres Strait Islander histories and cultures 

Asia and Australia's Engagement with Asia 

Sustainability 

Lesson 1 Land for Food	ACHGK048	The different types of landscapes and their distinctive landform features
Lesson 1 Land for Food	ACHGK051	The human causes and effects of landscape degradation
Lesson 1 Land for Food	ACHGS058	Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate
Lesson 1 Land for Food	ACHGS060	Apply geographical concepts to draw conclusions based on the analysis of the data and information collected
Lesson 1 Land for Food	ACHGS061	Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose, using geographical terminology and digital technologies as appropriate
Lesson 2 Noongar Landscape	ACHGK049	The aesthetic, cultural and spiritual value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples
Lesson 2 Noongar Landscape	ACHGS059	Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends and infer relationships
Lesson 3 Grain-Growing Regions of Australia	ACHGK048	The different types of landscapes and their distinctive landform features
Lesson 3 Grain-Growing Regions of Australia	ACHGS057	Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies
Lesson 3 Grain-Growing Regions of Australia	ACHGS058	Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate
Lesson 3 Grain-Growing Regions of Australia	ACHGS060	Apply geographical concepts to draw conclusions based on the analysis of the data and information collected
Lesson 4 Sustainable Seafood	ACHGK051	The human causes and effects of landscape degradation



Australian Curriculum Links

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Lesson 4 Sustainable Seafood	ACHGK052	The ways of protecting significant landscapes
Lesson 5 Wheat, Weeds and Adaptation	ACHGK051	The human causes and effects of landscape degradation
Lesson 5 Wheat, Weeds and Adaptation	ACHGK052	The ways of protecting significant landscapes
Lesson 6 Fire on the Land	ACHGK053	The causes, impacts and responses to a geomorphological hazard
Lesson 6 Fire on the Land	ACHGS056	Collect, select and record relevant geographical data and information, using ethical protocols, from appropriate primary and secondary sources
Lesson 6 Fire on the Land	ACHGS057	Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies
Lesson 6 Fire on the Land	ACHGS058	Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate
Lesson 6 Fire on the Land	ACHGS059	Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends and infer relationships

Supplementary activity cards relate to these learning outcomes:

It's a Wash-Out! (ACHGK050 – geomorphic processes and landforms)

Erosion Action (ACHGK051 – causes of erosion)



Facts about the Australian agricultural industry

- The gross value of Australian agriculture increased by \$3.7 billion from 2014–15, to \$58.1 billion in 2015–16.
SOURCE: ABARES, *Agricultural Commodities – June Quarter 2017*.
- In Australia, individuals spent on average \$4739 for food in 2015–16. This includes eating out and non-alcoholic beverages. This amount has risen by 16% during the past six years.
SOURCE: ABS, *Household Expenditure Survey, Australia: Summary of Results, 2015–16, Catalogue No.6530.0*.
- Food imports, particularly for processed food, accounted for only 15 per cent of household food consumption in Australia in 2015–16.
SOURCE: Hogan, Lindsay. (2017) *Food demand in Australia: Trends and food security issues*. ABARES research report 17.7, Canberra.
- Out of the \$58.1 billion worth of food and fibre Australian farmers produced in 2015–16, 77 per cent (\$44.8 billion) was exported.
SOURCE: ABARES, *Agricultural Commodities – June Quarter 2017*
- More than 99% of Australia's agricultural businesses are wholly Australian owned, owning 88% (or 343.3 million hectares) of Australia's agricultural land. Wholly Australian owned businesses also control 87% of Australia's agricultural water entitlements (or 13.3 million megalitres).
SOURCE: ABS, *Agricultural Land and Water Ownership, 2015–16, Catalogue No. 7127.0. 2017*
- As of May 2017, 304,200 people were employed in the Australian farm sector — accounting for about 3% of the national workforce.
SOURCE: Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, May 2017 Catalogue No. 6291.0.55.003*.
- Across the supply chain agriculture powers 1.6 million jobs.
SOURCE: *Australia's Farm Dependent Economy: Analysis of the role of Agriculture in the Australian Economy*.
- 216,100 males and 88,100 females are employed in the Australian farm sector
SOURCE: Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, May 2017 Catalogue No. 6291.0.55.003*.
- Agricultural businesses occupy and manage 48% of Australia's landmass, as such, they are at the frontline in delivering environmental outcomes on behalf of the broader community.
SOURCE: Australian Bureau of Statistics, *Land Management and Farming in Australia, 2015–2016, Catalogue No. 4627.0*.
- At 30 June 2016 there were 371 million hectares of agricultural land in Australia, a 1.4% increase on the previous year.
SOURCE: Australian Bureau of Statistics, *Land Management and Farming in Australia, 2015–2016, Catalogue No. 4627.0*.
- Australian primary industries have led the nation in reducing greenhouse gas emissions intensity — a massive 63% reduction between 1996–2016.
SOURCE: Australian Bureau of Statistics, *Australian Environmental-Economic Accounts, 2017, Catalogue No. 4655*
- Australian water consumption decreased in 2014–15 by 7% from 2013–14. The largest decrease in water consumption was in the agriculture industry.
SOURCE: Australian Bureau of Statistics, *Water Accounts, 2014, Catalogue No. 4655*.
- Agricultural businesses spend a significant amount on managing pest animals and weeds. An average of \$19,620 was spent per agricultural business on undertaking pest animal and weed management activities.
SOURCE: Stenekes, N, Kancans, R and Binks, B, 2017, *Pest animal and Weed Management Survey: National landholder survey results*, ABARES research report 17.5, May. CC BY 4.0.
- Australian farmers are among the most self-sufficient in the world, with government support for Australian farms representing just 1% of farming income. By comparison, in Norway it is 62%, Korea 49%, China 21%, European Union 19% and United States 9%.
SOURCE: OECD (2017), *Agricultural Policy Monitoring and Evaluation 2017*, OECD Publishing, Paris.



Virtual video excursions

Let's get started

All Industries

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If this is your first time teaching with the From Paddock to Plate Schools Program, welcome! When planning your lessons, you may first like to read the Welcome Guide on our website.

www.frompaddocktoplate.com.au/school-programs/

Assessing prior knowledge

Kick off by understanding the level of knowledge your students have of farming in Australia. This will determine your structure of delivery.

- ASK the students to describe and list what they know about farming in Australia.
- EXPLORE the facts about Australian agriculture (page 4).
- BRAINSTORM and gather ideas, questions and information from the class and use this as a platform to begin this unit. What information do students want to confirm, check, debate or explore?
- DISCUSS any questions that arise.



Now is the time to choose and watch a selection of the **From Paddock to Plate Virtual Excursions**.

You can find them all on the From Paddock to Plate website. Log in and choose your year level, subject or industry of interest:

www.frompaddocktoplate.com.au

Ask students to reflect on what they already know about this industry and what the video showed them that was new, or that changed their thinking.



WATCH
THE VIRTUAL
EXCURSION





ALMONDS

Almonds

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Ask students first to reflect on the *From Paddock to Plate Almonds Virtual Video Excursion*:

- How do almonds grow?
- What does an orchard look like?
- What can they say about the paddock to plate journey of almonds and almond products?
- What did they learn that they hadn't considered before?
- What would they like to know more about the almonds industry in Australia?

Facts and Vocabulary - Almonds

Facts about the Australian almond industry

- Australian growers produce approximately 10% of the total volume of almonds grown in the world.
- Orchard area planted to almonds increased by 15.8% or 4,904 hectares in 2016 to now total 35,886 hectares
- The number of almond trees now planted in orchards totals more than 10 million.
- Two million virus tested buds were delivered by the ABA to nurseries for grafting to produce healthy trees
- 2016 production of 82,333 tonnes was slightly less than the 2015 harvested crop
- Australia produced 7.7% of the global crop to remain the world's second largest producer behind the USA that grew 80% of world production
- Almonds were 62% of Australia's total tree nut crop that includes macadamias, walnuts, pistachios, hazelnuts and chestnuts (measured as inshell tonnage)
- 97% of almond orchards are efficiently irrigated using drip systems managed by soil moisture monitoring technology
- Annual per capita consumption of almonds in Australia is increasing strongly and exceeded one kilogram for the first time in 2016/17
- Australia ranks 6th in per capita consumption globally
- Domestic sales tonnage increased by 9.9%
- 46.7% of Australian households purchased almonds in the year ending February 2017
- Almond demand by manufacturers was boosted with 274 new products reaching supermarket shelves in 2016
- Australian almonds were exported to 46 countries
- Almond exports earned the nation \$464 million
- For every one tonne of almonds sold in Australia, 2.7 tonnes were sold overseas
- India was the single largest destination for exports
- Europe as a region consumed 43.2% of Australia's almond exports with sales of \$200.3 million
- East Asia is an emerging market for Australian almonds taking 13.8% of total exports

SOURCE: ABS, Household Expenditure Survey, Australia: Summary of Results, 2015–16, Catalogue No.6530.0.



Useful words and phrases

- Activated almonds
- Almond meal
- Almond milk
- Australian Stock Exchange
- Bacteria
- Belly dumper
- Biomass
- Blanch
- Conveyor belt
- Deciduous
- Drupe
- Export
- Fertigation
- Foliage
- Geographic diversity
- Hi vis clothing
- Hulling process
- Husk
- Irrigation
- Kernel
- Laser sorter
- Microorganisms
- Non-pollinator
- Pasteurisation
- Pollination
- Prune
- Quality assurance
- Renewable energy
- Salmonella
- Self-pollinator
- Shelling
- Stock feed
- Stock pad
- Stockpile
- Weighbridge



Lesson 1

Land for Food

Themes

Environment	Biodiversity	Productivity	Soil management
Food security	Urbanisation		

Getting started

Using photographs and maps of your state, students IDENTIFY different types of landscapes, including coastal, riverine, arid, mountain and karst landscapes.

Provide a map showing the area around Mildura, in Victoria's North West.

Students use a variety of maps, showing features such as the geology, water sources, transport links and climate of the Mildura region. They locate and INVESTIGATE the type of landscape that Select Harvests (this almond orchard) is located on at Robinvale near Mildura.



In a short written or spoken text, they explain why this land is suitable for almond production. Students consider climate, soil, water and transport to market.

In pairs, ask students to DISCUSS and come up with possible explanations for why the company, Select Harvests, has diversified its geographic locations to grow its almonds. Why have they established orchards in several different areas? Students CONSIDER economic reasons, climate and weather conditions, water sources and eliminating potential risk in a changing environment.



"In terms of geographic diversity, we have farms in Victoria but we also have farms in NSW and South Australia. Generally, the area to grow almonds is where you have lots of sun, you've got some rain, but also importantly at night it gets cool especially in the winter months so the trees can go dormant. We go across different states so if we have a rain event in Victoria, then some of the product coming from NSW shouldn't be affected by the same rain event. Having geographic diversity gives us a balanced portfolio to ensure, that on average, we get a good crop."

(12:25 – 12:59)

Almonds

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ACHGK048

The different types of landscapes and their distinctive landform features

ACHGK051

The human causes and effects of landscape degradation

ACHGS058

Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate

ACHGS060

Apply geographical concepts to draw conclusions based on the analysis of the data and information collected

ACHGS061

Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose, using geographical terminology and digital technologies as appropriate





Lesson 1: Land for Food (continued)

Land loss



Students RESEARCH and IDENTIFY at least three reasons why horticulture businesses of all types are slowly losing land on which to grow their produce. DISCUSS their findings, which could be presented as a poster, short report, film or diagram with notes. Source material below may assist, but students should use a variety of authoritative print and online sources for their research.

Recommended source material:

‘What were once quiet rural communities, Camden and Oakdale are now fairly urbanised and further development is likely as town centres expand. Sydney’s west is expected to bear the brunt of more than half of the population growth in Sydney in the next 20 years. Areas that have traditionally been used to grow food are now slated for housing, particularly around the Camden region where the population is expected to grow from 88,000 in 2017 to more than 226,000 by 2036. Mr Biel said when he started his business three decades ago, there were only 18,000 people living in the area. A search on one real estate website showed 16 housing estates either new or in development between Prestons, Leppington, Campbelltown, Oran Park and Spring Farm. Research published last year by the University of Technology Sydney found that if the city continued to develop agricultural land, it could lose more than 90 per cent of its current fresh vegetable production. Total food production could shrink by 60 per cent.’

– *Sydney squeeze: Food producers losing land to developers, fresh food declining* by Sarah Gerathy and Amanda Hoh, ABC News, 20 March 2017: <https://www.abc.net.au/news/2017-03-20/sydney-squeeze-food-producers-losing-land-to-developers/8365020>

‘In South Australia, much of Adelaide’s fresh produce is grown around the city’s fertile fringe. In April 2019, it will become illegal to subdivide rural land for residential housing across 8000 square kilometres designated for environment and food production. In both NSW and Victoria, governments are taking steps to increase the resilience of their city foodbowls by providing certainty to ensure farm viability into the future. Mutually beneficial relationships can be developed between cities and the farmers on their fringes. Farmers and agri-businesses need viable commercial conditions, a fair price for produce, land security and a social licence to operate. City residents benefit from access to fresh produce, amenity, low food miles and agri-tourism activities on nearby farms.’

– *Protecting Brisbane’s foodbowl* by Stuart Armitage, Queensland Country Life, 17 December 2018: <https://www.queenslandcountrylife.com.au/story/5815518/protecting-brisbanes-foodbowl/>

**Recommended source material (continued):**

'The NSW Government is considering an agricultural enterprise credit scheme to reward farmers for productive use of their land, by banking saleable credits based on the value or amount of food produced in any year. That way land in the primary production zone can be given a dollar value that can then be sold to developers. They can use it to increase the density of their projects by adding extra storeys to a building, for example. The farmland that has been 'traded' is preserved and cannot be used for anything other than farming. Mr Sinclair said the model was working in parts of the United States such as Lancaster County in Pennsylvania or Marin County on the fringes of San Francisco.'

– *How to save Australia's remaining farmland as demand for housing continues* by David Claughton, ABC News, 13 April 2018: <https://www.abc.net.au/news/rural/2018-04-13/how-to-save-australias-remaining-farmland/9627516>

'As cities grow, perhaps our most serious concern should be how they expand out into the surrounding countryside. Contrary to popular belief, over the past century urban settlements have not only expanded demographically, they have also sprawled outwards – covering some of the world's most valuable farmland in the process. The result has been a steady de-densification of urban settlements, by about –2% per annum. Even where inner-city areas have densified over the past few decades (Copenhagen, for example), the citywide trend is still for an overall reduction in average densities. In 2010, the total area covered by all the cement, asphalt, compacted clay, park areas and open spaces that comprise the footprint of the world's urban settlements was around 1 million sq km. In comparison, the total area of France is 643,000 sq km. If the urban population and long-term de-densification trends continue, the area of the planet covered by urban settlements will increase to more than 3 million sq km by 2050. And since the most intensively cultivated farmland is typically located near where the bulk of the food is consumed, much of this additional 2 million sq km is currently our most productive farmland. In short, continued urbanisation in its current form could threaten global food supplies at a time when food production is already not keeping up with population growth.'

– *The curse of urban sprawl: how cities grow, and why this has to change* by Mark Swilling, The Guardian, 12 July 2016: <https://www.theguardian.com/cities/2016/jul/12/urban-sprawl-how-cities-grow-change-sustainability-urban-age>



Food for thought

Ask the class to IMAGINE if the world's soil ran out – or, in other words, was either degraded to the point that it cannot support healthy plant crops or pasture, and/or was subject to major erosion events from wind and water (e.g. massive dust storms stripping off the top soil in a region of degraded soils). They look for recent world examples of these events and seek the causes of soil degradation.

In order to do this, students may need a review of what soil is, what makes it viable for agriculture, and the difference between top soil and sub-soil.

What would this scenario of world-wide degraded soil mean? In pairs, have students DESCRIBE the impact that this would have on almond production, food production in general, water quality and security, human and animal health, and the economy.



Students RESEARCH an alternative to soil for growing nuts. What kind of farm could they design for future food?

Alternatively, students research and present their findings on the question: How do we build or make more soil?

As a class, DISCUSS and debate this provocation. Students draw on their research for examples and data to support their arguments in the debate:

Soil has been largely ignored since the Industrial Revolution, but people are beginning to realise that care of the soil is an important investment in our future.

Recommended source material:

'A rough calculation of current rates of soil degradation suggests we have about 60 years of topsoil left. Some 40% of soil used for agriculture around the world is classed as either degraded or seriously degraded – the latter means that 70% of the topsoil, the layer allowing plants to grow, is gone. Because of various farming methods that strip the soil of carbon and make it less robust as well as weaker in nutrients, soil is being lost at between 10 and 40 times the rate at which it can be naturally replenished. Even the well-maintained farming land in Europe, which may look idyllic, is being lost at unsustainable rates. We haven't heard about this probably because soil isn't sexy. People don't always think about how it's connected with so many other things: health, the environment, security, climate, water. For example, agriculture accounts for 70% of our fresh water use: we pour most of our water straight onto the ground. If soil is not fit for purpose, that water will be wasted, because it washes right through degraded soil and past the root system. Given the enormous potential for conflict over water in the next 20–30 years, you don't want to exacerbate things by continuing to damage the soil, which is exactly what's happening now.'

– *What If the World's Soil Runs Out?* Interview with Professor John Crawford of the University of Sydney for TIME, 14 December 2012: <http://world.time.com/2012/12/14/what-if-the-worlds-soil-runs-out/>

**Recommended source material (continued):**

'A third of the planet's land is severely degraded and fertile soil is being lost at the rate of 24bn tonnes a year, according to a new United Nations-backed study that calls for a shift away from destructively intensive agriculture. The alarming decline, which is forecast to continue as demand for food and productive land increases, will add to the risks of conflicts such as those seen in Sudan and Chad unless remedial actions are implemented, warns the institution behind the report. "As the ready supply of healthy and productive land dries up and the population grows, competition is intensifying for land within countries and globally," said Monique Barbut, executive secretary of the UN Convention to Combat Desertification (UNCCD) at the launch of the Global Land Outlook. "To minimise the losses, the outlook suggests it is in all our interests to step back and rethink how we are managing the pressures and the competition." The Global Land Outlook is billed as the most comprehensive study of its type, mapping the interlinked impacts of urbanisation, climate change, erosion and forest loss. But the biggest factor is the expansion of industrial farming. Heavy tilling, multiple harvests and abundant use of agrochemicals have increased yields at the expense of long-term sustainability. In the past 20 years, agricultural production has increased threefold and the amount of irrigated land has doubled, notes a paper in the outlook by the Joint Research Centre (JRC) of the European commission. Over time, however, this diminishes fertility and can lead to abandonment of land and ultimately desertification. The JRC noted that decreasing productivity can be observed on 20% of the world's cropland, 16% of forest land, 19% of grassland, and 27% of rangeland.'

- *Third of Earth's soil is acutely degraded due to agriculture* by Jonathan Watts, The Guardian, 12 September 2017: <https://www.theguardian.com/environment/2017/sep/12/third-of-earths-soil-acutely-degraded-due-to-agriculture-study>



BEEF

Beef

Year 8

Stage 4



Ask students first to reflect on the *From Paddock to Plate Beef Virtual Video Excursion*:

- What does a cattle farm look like?
- What can they say about the paddock to plate journey of beef?
- What are three technologies students saw in the video?
- What did they learn that they hadn't considered before?
- What would they like to know more about the beef industry in Australia?

Facts and Vocabulary - Beef

Facts about the Australian beef industry

- In total, Australian beef cattle farmers produce 2.5 million tonnes of beef and veal each year
SOURCE: ABARE, Australian Commodity Statistics, 2016.
- The beef industry accounts for 55% of all farms with agricultural activity.
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- The gross value of Australian cattle and calf production (including live cattle exports) in 2015–16 was \$12.7 billion
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- Australians eat an average 26kg of beef per person, per year. Remarkably, this has remained relatively constant for the past 15 years
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- In 2015–16, Australians spent \$8.5 billion on beef. In terms of volume, beef is the third most popular fresh meat consumed through the food service industry after chicken and seafood
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- Australians remain the second-largest consumers of meat per capita, and the sixth-largest consumers of beef in the world, averaging 26 kg per person in 2016
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- Australia exported 962,983 tonnes of beef in 2016–17, worth \$8.5 billion. The major export markets for beef are Japan (29%), the United States (21.7%) and Korea (16.8%).
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- Australian live cattle exports are worth \$1.2 billion in 2016–17 – predominantly exported to Indonesia (58.7%), Vietnam (17.7%) and China (8.2%).
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.
- Australia produces 3% of the world's beef, and was the third largest beef exporter during 2016–17.
SOURCE: Meat & Livestock Australia, Fast Facts 2017: Australia's Beef Industry.



Useful words and phrases

- Abattoir
- Arbitrage
- Australian Certified Organic
- Barley
- Bear market
- Boning room
- Bovine
- Bovine spongiform encephalopathy (also known as 'mad cow disease')
- Bull
- Bull market
- Butcher
- By-product
- Carcase weight
- Chorizo
- Dressed weight
- Eastern Young Cattle Indicator (EYCI)
- Export market
- Fat score
- Feedlot
- Grain-fed
- Grass-fed
- Heifer
- Holistic
- Livestock agent
- Marbling
- Meat Standards Australia
- Muscle score
- National Livestock Identification System
- Omega-3
- Organic
- Pastrami
- Premium
- Restocker
- Rotational grazing
- Rump steak
- Sold to the trade
- Steer
- Stocking density
- Store sale
- Trade buyers
- Vealer
- Yearling
- Wagyu



Lesson 2

Noongar Landscape

Themes

History	Community	Conservation	Natural heritage
Environment	Culture		

Getting started

As a class READ the two recommended sources below or share the text for students to read.

Recommended source material:

‘Boyup Brook was originally inhabited by Aboriginal people of the Bibbulmun Tribe. The name derived from the Aboriginal word “Booyup” meaning “Place of Big Stones” or “Place of Big Smoke”. The large stones are referring to the large Granite rocks surrounding the Upper Blackwood area and the Big Smoke refers to the smoke from the burning of Grasstrees once referred to as Blackboys.’

– Shire of Boyup Brook

‘The Aboriginal name Koi Kyeunu-ruff (‘place of ever moving about fog and mist’) is an appropriate name indeed for the Stirlings. A wildflower and plant reserve of international significance, the Stirlings’ springtime wildflower display (August to November) is justifiably famous. Blessed with over 1500 plant species, rare orchids, mountain bells and banksias abound. [There are] 148 bird species – 90 of which breed in the park – and 19 species of native mammals.’

– Mount Barker Visitors Centre

Beef

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ACHGK049

The aesthetic, cultural and spiritual value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples

ACHGS059

Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends and infer relationships



Culture and land



Students LOCATE the Bibbulmun traditional territories on a map such as the AIATSIS Map of Indigenous Australia:

- <https://aiatsis.gov.au/explore/articles/aiatsis-map-indigenous-australia>

Students locate Blackwood Valley Organic Beef (at Boyup Brook) on a print or digital map.

They PLOT each of these areas on their map as well as the Bibbulmun Track route.



Lesson 2: Noongar Landscape (continued)

Bibbulmun culture

Students EXPLORE Noongar and Bibbulmun culture using the resources below. (Noongar is the name for the cultures of the broad South-West region; Bibbulmun refers to the people of the south-west tip of Western Australia as generally identified on the AIATSIS map.)

Prompt students to consider the multilayered meanings (material, cultural and spiritual wellbeing) associated with landscapes and landforms along the Bibbulmun Track and the Wagyl Kaip and Southern Noongar cultural region.



Students respond with a written or oral piece about how people are connected to the land, using Noongar or Bibbulmun examples for the area around the Blackwood Valley farm.

Teacher resources:

- Phenomenom – Welcome to Country (Wardandi Bibbulmun) (video, duration 6:08): <http://phenomenom.com.au/topic/good-chat/the-one-with-the-welcome/>
- Kartdijn Noongar – Noongar knowledge: <https://www.noongarculture.org.au/>
- About Noongar Language: <https://www.noongarculture.org.au/language/?searched=yes>
- Walk the Bibbulmun Track: <https://www.bibbulmuntrack.org.au/>
- AIATSIS Map of Indigenous Australia: <https://aiatsis.gov.au/explore/articles/aiatsis-map-indigenous-australia>

Activity card:

It's a Wash-Out!

Students CONSIDER and LIST the many causes of erosion on a farm.

For example:

- | | | |
|------------|-----------------|-----------------------------------|
| • Rainfall | • Temperature | • Construction |
| • Flooding | • Overgrazing | • Foot traffic – human and animal |
| • Rivers | • Deforestation | |
| • Wind | • Vehicles | |

Take each of these causes and THINK of at least two methods that could be implemented to prevent and stop erosion (e.g. swales).

DESCRIBE each method in detail and DRAW up a plan that you could give to a farmer struggling with erosion on his/her property.





CAREERS

Careers

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Ask students first to reflect on the *From Paddock to Plate Careers Virtual Video Excursion*:

- What are some of the varieties of grains they saw in the video?
- What different careers do people have in the grains industry?
- Are there careers they had not heard of before? What were they?
- Do they think new types of skills and expertise will be needed in the future in the grains industry? Why (or why not)?
- Are there any careers they would like to explore in more detail?

Facts and Vocabulary - Careers

Facts about careers in the Australian agricultural industry

- About 50% of all jobs in the agriculture industry are in capital cities. These jobs include environmental management, research, development, agribusiness and education.
SOURCE: St Joseph's College Geelong, Weekly Career News, 19 June 2018
- The demand for agricultural science graduates grew strongly over the past 5 years and around 6000 job openings will be available by 2020.
SOURCE: St Joseph's College Geelong, Weekly Career News, 19 June 2018
- Experts are needed in the areas of sustainable farming practices, land management, land conservation, climate change practices, food security, agricultural research and policymaking.
SOURCE: St Joseph's College Geelong, Weekly Career News, 19 June 2018
- 'Here are the top 10 most in-demand and highest-paying agriculture careers:
 10. Agricultural Operations Manager: Not to be confused with farm managers, agricultural operations managers are typically in charge of maintaining processes in huge agribusinesses such as grain manufacturing and mills.
 9. Animal Geneticist: Nope. Animal geneticists aren't responsible for creating the Indominus Rex (a writer did that!), but they are responsible for discovering what makes animals weak and what keeps them strong.
 8. Food Scientist: If you've ever wondered who's responsible for creating the nutritional information printed on the back of your pack of chips, well, you've guessed it: it's food scientists.
 7. Agricultural Engineer: If you're fascinated with the film Transformers, and you enjoy the idea of machines helping humans, then you might want to be to be an agricultural engineer.
 6. Agronomy Sales Manager: One of the main drivers of the agricultural industry is agronomy sales managers. These professionals are responsible for training the team that will travel to different places to educate farmers on how to care for their land and crops properly.
 5. Bioinformatics Scientist: Plant and animal life is widely diverse, which is why gathering and updating information on all of them is incredibly difficult – and that's where bioinformatics scientists come in.
 4. Environmental Engineer: There would be nothing to harvest if the conditions for planting and growing are poor; that's why the work of environmental engineers is so important to agriculture.
 3. Biochemist: Biochemists study and analyse different living organisms to look for new ways to improve human lives. In the field of agriculture, their work primarily involves developing new crops that are more resistant against natural elements like drought, storms or even insect infestations.
 2. Agricultural Economist: To work as an agricultural economist, you must be prepared to wear different hats. Not only do they work as researchers and market analysts, but they're also business advisors, consultants and land appraisers.
 1. Agricultural Lawyer: Agricultural lawyers are responsible for mitigating disputes on land while making sure that all government regulations are adhered to.'



Useful words and phrases

- Aptitude
- Attitude
- Body language
- Budget
- Career
- Career clusters
- Communication
- Consumers
- Coworkers
- Decision-making process
- Discriminate
- Economy
- Employee
- Employer
- Ethics
- Entrepreneur
- Free enterprise
- Full-time
- Goods
- Income
- Interest inventory
- Income tax
- Interests
- Job market
- Job
- Learning styles
- Lifestyles
- Minimum wage
- Overtime
- Part-time
- Personality
- Producers
- Salary
- Skill
- Supervisor
- Time management
- Values
- Wages
- Workers' compensation
- Work place



Lesson 3

Grain-Growing Regions of Australia

Themes

Environment	Agriculture	Productivity	Geographic diversity
Climate	Food security		

Getting started

Students use maps to IDENTIFY important landforms in their state or region.

They USE the Global Positioning System (GPS) to make a map of the features of a chosen landform.

In pairs or groups, students INVESTIGATE the type of landscape that Jono's farm is located on in the Wheatbelt region of Western Australia. They find out why this land is suitable for grain production. They research and propose map boundaries for the Wheatbelt region, using data including soil type and climate to define the region. They plot the region on a map.

Considering climate

Students conduct deeper RESEARCH into the climate of the Wheatbelt region of Western Australia and IDENTIFY how the weather is a significant factor in the geographic locations of wheat crops and therefore the impact that a changing climate and changing seasons are having on productivity.

Teacher resources:

- Bureau of Meteorology – Climate and past weather: <http://www.bom.gov.au/climate/>

(Or show students how to get there by visiting www.bom.gov.au and scrolling to the square at the bottom labelled 'Climate and Past Weather'.)

Students use the Paddock to Plate app page on the *From Paddock to Plate* website to find out what seasonal Australian produce is available right now.

- Paddock to Plate app page: <http://www.frompaddocktoplate.com.au/app/>

Australia's main grain-growing regions

Split the class into groups and assign them one of the three grain-growing regions below. (One region can be covered by more than one group.)

Careers

Year 8

Stage 4

ACHGK048

The different types of landscapes and their distinctive landform features

ACHGS057

Evaluate sources for their reliability and usefulness and represent **data** in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies

ACHGS058

Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate

ACHGS060

Apply geographical concepts to draw conclusions based on the analysis of the data and information collected





Lesson 3: Grain-Growing Regions of Australia (continued)

- Northern region of Queensland and northern New South Wales
- Southern region of southeastern Australia
- Western region, or Wheatbelt region of Western Australia

DEFINE the term 'agroecology' which is the study of ecological processes applied to agriculture.



Students prepare a statement of the agroecological features and grain-growing activity in their region. The activity in Getting Started should give them experience in creating a map of their region based on data gathered, and they should also go deeper, using authoritative sources to gather data and statistics, accessing maps and geographical data to create a detailed description and definition of their grain-growing region. Their statement should cover:

- characteristics of soil, water, landscape and land features;
- climate data;
- grain-growing statistics, such as yield, varieties grown, key markets, transport hubs for grain; and
- evidence of change in climate, economy and grain-growing practices of the region.

In their groups, students prepare a presentation about their grain-growing region, which may include posters, powerpoint slides or similar, animations or short videos.

Recommended source material:

'Geographically, the grains industry is defined by three broad agroecological regions.

The Northern Region

Encompassing Queensland and northern New South Wales, has generally high inherent soil fertility, although there is increasing evidence that this has been run down over time. It has relatively high seasonal rainfall and production variability compared with the other two regions. Both summer and winter crops are important for profit. Yield depends, to a significant degree, on conservation of soil moisture from summer-dominant rainfall. The Northern Region has the highest diversity of crop production, including maize, sorghum and tropical pulses as well as wheat, barley, winter-growing pulses and oilseeds. The Northern Region is the largest source of Australia's premium hard high-protein wheat for export and domestic use. Demand for feed grains from the region's important livestock industries is a key driver of grain production.

The Southern Region

Encompasses southeastern Australia, including central and southern New South Wales; Victoria; Tasmania; and south-eastern South Australia. It has a diverse suite of soils of generally low fertility and with many subsoil constraints, such as salinity, sodicity and toxic levels of some elements, although there are also some areas with very productive soils. Yield potential depends on seasonal rainfall, especially in autumn and spring, and there is less dependence on...



Lesson 3: Grain-Growing Regions of Australia (continued)

Recommended source material (continued):

'... stored soil moisture than in the Northern Region. Crop production systems are varied and include many mixed farming enterprises with significant livestock and cropping activities.

The Western Region

Comprises the cropping areas of Western Australia, where soil fertility is generally low to very low, and yields depend on winter and spring rainfall. In many areas, yields are low by world standards; this is compensated for by the large scale and degree of mechanisation of the enterprises. Long-term variability in seasonal rainfall and production is lower in the coastal areas than in the Northern and Southern regions. Wheat, barley, canola and lupins are the dominant crops, with livestock enterprises in mixed farming systems often of less importance. The Western Region has a relatively small population and feed industry, and consequently exports more than 85 percent of its grain production.'

– Grains Research & Development Corporation: <https://grdc.com.au/>

Careers in a time of change

Review these segments of the video with the class:

SUSIE



"Hey, I'm Susie and I'm an agronomist. That means I get to talk to lots of different farmers about what they do and their farming systems. I also get to possibly improve what they do as well. I love my career because I get to be out here all day, in paddocks, hands on, and talk to heaps of different people."

(0:58 – 1:18)

GEORGIA



"In my job, every day is different. The seasons are variable, so growers are always needing new information to help them grow the best crops they can. So why don't we go and check out where I work and I'll show you what I do."

(3:29 – 3:40)



"This is the MyCrop Barley app. The app helps growers to make the best variety choices for their farms based on the environment. What I mean by environment? The soil type and rainfall. This app also helps growers to select varieties that provide them with the best yield and also helps them choose varieties that will give them certain disease resistances."

(3:53 – 4:16)



Lesson 3: Grain-Growing Regions of Australia (continued)

EXPLAIN 'geographic diversity' and how this helps to spread the risk of changing climatic conditions in an industry, like grain, which relies so heavily on the seasons.

Review the source material below with the class:

Recommended source material:

'Wheat is the most abundant crop, occupying 22% of the total cultivated area in the world. The most intensive wheat cultivation occurs in the temperate latitudes of both hemispheres. Wheat is most prevalent in the Great Plains of the United States, the Canadian Prairie Provinces, the Indus and the upper Ganges Valleys, along the Kazakhstan and Russian border, and in southern Australia. Wheat is also found throughout Europe, in southern South America, in parts of eastern Africa, and in eastern China.'

– *Geographic distribution of major crops across the world* by Billie Leff, Navin Ramankutty & Jonathan A. Foley, *Global Biogeochemical Cycles* Volume 18, Issue 1
March 2004

'This year, Mr Nicoletti planted more than 83,000 hectares at his three locations, in the northern Wheatbelt at Mullewa, in the Central Wheatbelt around Merredin and south at Esperance. That's a crop roughly 80 square kilometres larger than the Pacific Ocean country of Tonga. His business is deliberately structured to spread seasonal risks of drought and other factors, by growing crops at various geographical locations, which are capable of capturing different rainfall patterns in any given year. Over 33 years, he's steadily built his business based on these sound risk management principles and the advantages of adopting greater economies of scale. But times are becoming more complicated and challenging due to the compound effects of several recent droughts and ongoing price volatility. Mr Nicoletti endured one of his toughest seasons last year with his 74,000/ha program ravaged by WA's worst drought in 20 years.'

– *The future of wheat growing* by Colin Bettles, *Farm Weekly*, 27 October 2011:
www.farmweekly.com.au/news/agriculture/cropping/general-news/the-future-of-wheat-growing/2337094.aspx

'Various projections for temperature, rainfall, drought and storms suggest that maintaining current grain yields will be difficult for Australia. In Western Australia, our biggest wheat growing state, WA Agriculture has predicted a 10% reduction in wheat yield. That reduction will be up to 30% in the most northern wheat growing areas. One of the greatest concerns is air temperatures rising above the optimum wheat growing temperature of 23°C. Seasonal conditions in the grain-growing regions are also critical to world supply and prices. The current Australian wheat crop looks bigger than the last, but is well down on the huge 2012 harvest. Luckily, it looks like a bumper harvest is coming from the Russian Federation...'



Lesson 3: Grain-Growing Regions of Australia (continued)

Recommended source material (continued):

'... But a poor season in one or two of the countries can have flow-on effects around the globe.'

– *Australia's farming future: can our wheat keep feeding the world?* By Ian Wright, Lecturer in Environmental Science, Western Sydney University, 6 June 2013: <http://theconversation.com/australias-farming-future-can-our-wheat-keep-feeding-the-world-14678>

Debate

With what they have learned about their assigned grain-growing region, students consider the question:

- What new and emerging skills and knowledge will be needed to maintain the grain industry in my region?

DISCUSS and DEBATE this question as a class or in groups.

Activity card:

Erosion Action

Students RESEARCH and LIST the causes of erosion on a farm, such as:

- rainfall;
- rivers;
- wind;
- overgrazing;
- deforestation;
- vehicles; and
- construction.

They PROPOSE methods that can be implemented on farms to prevent and stop erosion.

Students DESCRIBE each method in detail and DRAW up a plan that they could give to a farmer struggling with erosion on their property. Is there any specific expertise that would be required? What jobs would be needed?

Use the Paddock to Plate app to locate farmers in your area to discuss erosion issues that they are facing. Use this information to assist with your assignment.



FISH

Fish

Year 8

Stage 4



Ask students first to reflect on the *From Paddock to Plate Fish Virtual Video Excursion*:

- What does a typical day on a fishing boat look like?
- What can they say about the paddock to plate journey of Australian fish?
- What did they learn that they hadn't considered before?
- What would they like to know more about the fishing industry in Australia?

Facts and Vocabulary - Fish

Facts about the Australian fish industry

- Australia's wild capture fisheries and aquaculture industries contribute almost \$3 billion a year to Australia's economy.
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- More than 14,000 people are directly employed by the commercial fishing and aquaculture sectors and many of these jobs are based in regional areas.
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- Australia's Exclusive Economic Zone extends 200 nautical miles from the coast and is the world's third-largest fishing zone (8.1 million square kilometres).
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- Around 300 boats operate in Commonwealth fisheries.
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- More than 3.5 million Australians are recreational fishers.
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- On average, Australians eat 140 serves of seafood every year.
SOURCE: Australian Government, Department of Agriculture and Water Resources December 2017
- The volume of fishery and aquaculture production increased by 4 per cent between 2006–07 and 2016–17. During this period, the pattern of production changed significantly, shifting from the production of wild-catch stocks toward production of aquaculture products.
SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)
- Asia remains a major export destination for Australian fishery and aquaculture products. However, the pattern of Australian fishery and aquaculture exports has shifted towards the south-eastern China and Vietnam region. The major export product is rock lobster.
SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)
- Australia's apparent consumption of seafood increased, on average, at an annual rate of 0.8 per cent between 2006–07 and 2016–17, increasing 9 per cent overall in this period. Owing to faster population growth, apparent per person consumption of seafood declined over the same period, from 15 kilograms per person on an edible equivalent basis in 2006–07 to 13.9 kilograms per person in 2016–17.
SOURCE: Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)



Useful words and phrases

- Acoustic survey
- Algal bloom
- Artisan fishing
- Anadromous
- Antarctic convergence
- Aquaculture
- Beam trawling
- Benthos
- Biotoxins
- Bottom trawling
- Bycatch
- Casting
- Catadromous
- Cephalopods
- Cetacean
- Crustaceans
- Dredging
- Ectothermic
- Elasmobranch
- Endemic
- Estuary
- Farmed fisheries
- Fecundity
- Founder effect
- Gametes
- Ghost nets
- Habitat
- Hatchery
- Individual transferable quota (ITQ)
- Invertebrates
- Mariculture
- Marine mammal
- Meristics
- Migration
- Oceanodromous
- Plankton
- Shoaling
- Spawning
- Sustainable fishing
- Tag and release
- Threatened species
- Vertebrates
- Wild fisheries



Lesson 4

Sustainable Seafood

Themes

Environment
Regulation

Profitability
Food security

Technology

Biodiversity

Fish

Year 8

Stage 4

ACHGK051

The human causes and effects of landscape degradation

ACHGK052

The ways of protecting significant landscapes



Getting started

Review what Jim says about the place in which he fishes for a living:



"Australia has got very strict restrictions on our fisheries, on all the types of fisheries. So Australia is very sustainable. With us, we've got a quota and we can catch what we want in the quota, but I don't need all the quota because I only need small schools every day for consistency to keep the fresh market going."

(4:01 – 4:22)



"My zone is huge. I'm only fishing within two or three kilometers of my waters and I've got thousands of miles of it. So, super sustainable. I've got a lot of water out there to catch sardines."

(4:25 – 4:39)

As a class, find the region on a map and EXAMINE the features of the ocean environment. What can students glean from different types of maps, such as about tides and currents, ocean depth and water temperature throughout the year?

Evaluating environments

Students gather and EVALUATE different views about the value of the environment where Jim catches sardines, taking into consideration that his livelihood depends on this area of the ocean.

REFLECT on measures in place to protect this environment and DISCUSS how these practices link to ideas about environmental and seafood sustainability. Students use material from the video to make assumptions about how the fishing industry has changed over the last 2–3 generations.



Lesson 4: Sustainable Seafood (continued)



"In the old days, my father, he used to work with the birds. The birds used to tell him where the fish were and it was mainly day fishing. You'd circle the school where the birds had hit the water, but that doesn't tell you the quantity of the fish."

(2:59 – 3:12)



"With our technology, we've got sonar so I know the quantity, which way they are moving, but it's still very difficult. You've got to allow for the wind and the dolphins like to work with us as well. Sometimes they mess us up, but most of the time they help us."

(3:13 – 3:29)



"We used to bale the fish out with a big scoop net in the old days. This might be an old boat, but it's full of modern technology. Now we pump on the boat and pump off the boat, so we've got it easier than we used to have it."

(3:30 – 3:44)



"If I got two tonne a day, that's plenty, but I'm happy with one tonne. Sometimes we catch three, but no more than that. That's enough."

(4:40 – 4:47)



"Every day, if the weather is fine we fish, because you have to allow for the bad weather days."

(4:48 – 4:53)

Recommended source material:

'Sustainability' is a very hard thing to define, especially when it relates to seafood. There are many different factors that need to be assessed, such as a species' total population, breeding habits (how long it takes for a population to regenerate), migration routes, and fishing methods employed, as well as the effects of fishing pressure on the broader ecosystem. And that's just wild fisheries... Aquaculture (fish farming) is another kettle of fish entirely! It's no wonder that different groups and individuals sometimes come to different conclusions about what is sustainable and what isn't. Two common species well loved by most Australian's are Barramundi and Snapper. Both are tricky, so we thought we better have a closer look at them.

- **SNAPPER:** Snapper is caught by a range of fishing methods throughout Australia, from the south of Qld right around to central WA. It is also imported from NZ. Most have been overfished in the past, and they are in various states of recovery. The Victorian stock is currently the healthiest and was accredited as sustainable by the Sustainable Australian Seafood Assessment Program (SASAP) in 2011.



Lesson 4: Sustainable Seafood (continued)

- **BARRAMUNDI:** The Barramundi available to us in Australia comes from a range of sources. It may be imported farmed product, local wild, or local farmed. So how are we to decide which Barramundi we should be eating? The AMCS recommends that consumers 'Say No' to imported farmed Barra as well as local product that is the result of sea cage aquaculture, while advising that you 'Think Twice' about local fish from the wild or land-based farms. However, Cone Bay Barramundi, a product of sea cage aquaculture, has been identified as sustainable by the Sustainable Australian Seafood Assessment Program (SASAP) due to its best practice management and low environmental impact.'

– Sustainable Table

'Australia's long-term commercial fish catch is estimated to be millions of tonnes more than what has been officially reported, analysis has found. A catch of more than 8 million tonnes has been reported for 1950–2010 to the United Nations Food and Agriculture Organisation. However, researchers from the University of British Columbia's Fisheries Centre estimate that an extra 4 million tonnes of fish was caught in that period, although it was deemed to be "discards".'

– *Australia's commercial fishing industry catches millions of tonnes more than reported: researchers* by Jake Sturmer, ABC Online, 21 May 2015: <https://www.abc.net.au/radio/programs/am/australian-commercial-fish-catch-may-be-millions/6485866>

'Look around at all the new sushi joints and the lobster roll trucks. We're taking a heck of a lot of fish out of the sea. Luckily, the UN Food and Agriculture Organization (FAO), which tracks how many we've been catching, says catches have remained fairly stable for nearly two decades—a reassuring sign. But that's probably wrong. Even way wrong. Over the last six decades, we've plucked at least 50% more fish from the ocean than official data told us, suggest data reconstructions by Daniel Pauly and Dirk Zeller of the University of British Columbia, in a Jan. 19 paper in Nature Communications. The researchers tracked a steep decline since the mid-1990s, which could mean seafood is growing scarcer, upping food security risks. In some places, we're likely catching fish too quickly for them to replace themselves. The biggest absolute decline comes from industrial fishing. "We're fishing harder, but getting less out of it," explained Boris Worm, a marine ecologist at Dalhousie University, to Quartz. Worm is not affiliated with the study. "It's like squeezing a lemon harder, but getting less juice out of it." If that's true, why doesn't FAO data show the same deep drops in fish stocks? There are two forms of fishing, explains Worm. There's the easily visible, documentable form reported by law-abiding fishermen to their regulators, which eventually finds its way into the FAO estimates. But there's also a "hidden form"—for instance, illegally caught fish, or those landed by subsistence fishermen in poor countries. Pauly and Zeller have undertaken what Worm calls "the Herculean task" of finding, estimating, and adding up six decades worth of that "hidden form."

– *We may be running out of fish far faster than we realized* by Gwynn Guilford, Quartz, 19 January 2016



Lesson 4: Sustainable Seafood (continued)

Teacher resources:

- National Geographic: <http://education.nationalgeographic.org/encyclopedia/sustainable-fishing/>
- Sustainable Table – These seafood species are OK to (mindfully) eat! Phew: <http://sustainabletable.org.au/TableTalk/tabid/53/EntryId/122/These-seafood-species-are-OK-to-mindfully-eat-Phew.aspx>
- Australian Conservation Foundation – Our Much-Loved Reef: https://www.acf.org.au/our_much_loved_reef
- Sustainable Table – Fish + Seafood.: <http://sustainabletable.org.au/Hungryforinfo/FishyBusiness/tabid/143/Default.aspx#5>
- ABC News – Australia’s commercial fishing industry catches millions of tonnes more than reported: researchers: www.abc.net.au/news/2015-05-21/australia-commercial-fish-catch-bigger-than-official-reports/6485134
- Nature Communications – Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining: www.nature.com/ncomms/2016/160119/ncomms10244/abs/ncomms10244.html
- Quartz – We may be running out of fish far faster than we realized: <http://qz.com/597367/we-may-be-running-out-of-fish-far-faster-than-we-realized/>

Research project

FIND OUT about Sustainable Seafood Week; an event held every year in four American cities to talk about sustainable food. ‘Whether you’re a fisherman, a chef, an industry pro, an environmentalist or simply a seafood lover, we all have a stake in the future of fish.’ – www.sswnational.com

PREPARE and PITCH a presentation to the Australian Government as to why you believe a Sustainable Seafood Week should also be celebrated in Australia.

Research project

EXPLORE and DISCOVER why chef and broadcaster, Hugh Fearnley-Whittingstall’s campaign ‘Fish Fight’ was so successful in achieving its goals of seafood sustainability in Europe and the UK.

Points worthy of noting include:

- ‘Hugh was appalled at how much edible fish was being caught in the North Sea and then thrown back overboard, dead, because of the crazy EU laws;
- 50% thrown back dead;
- www.fishfight.net was created to host a petition against this senseless waste;
- 870,000+ from 195 countries felt the same way and added their names to the petition;
- 3 years later and Europe’s politicians have voted to ban discards;
- the campaign has changed the way the consumers across Europe buy their fish;



Lesson 4: Sustainable Seafood (continued)

- 105,000 iPhone app downloads putting up-to-date, sustainable choice in the nation's pockets;
- all the major UK supermarkets and tuna suppliers were persuaded to change their fish sourcing policies;
- sales of undervalued fish increased by 150% in some supermarkets;
- Hugh asked Fish Fighters to Tweet the supermarkets to ask what their prawns were eating; and
- a fish fight investigation found illegal and unsustainable fish being fed to king prawns in Thailand.' – www.fishfight.net/story.html

DEBATE and POSITION viewers to accept a particular point of view using assumptions about them.

5 steps to sustainable seafood

1. Diversify your choice & switch your fish!

'Populations of popular seafood species such as Shark (Flake*), Tuna and Swordfish have been reduced to only 10% of what they were in the 1950s. Try something different, eat lower on the food chain (these fish regenerate more quickly) and give the popular species a break to preserve the balance of the ocean and ensure that future generations can enjoy them too.' – Sustainable Table

2. Educate yourself and ask questions

'In Australia, country of origin labelling is now legally required for seafood products, but there's still a lot missing from labels, such as fishing and farming method and standardised species names. Be a savvy shopper, ask questions and use our easy Switch Your Fish Guide to make an informed choice.' – Sustainable Table

3. Buy local

'A whopping 72% of the seafood Aussies eat is imported. Cheap imports are often fished and farmed without the same regulation, which adds to the environmental pressure placed on our oceans. Support local communities and sustainable fisheries where possible and if you are buying fish from overseas look for accreditation logos (i.e. MSC) and sustainable fish species.' – Sustainable Table

4. Fish is still meat so make it a treat

'13 of the world's 17 fishing zones have already been depleted or are in serious decline. Australians chomp through an average of 25kg of seafood each year, the world average is 17kg per person. Want to save the ocean and preserve fish for future generations? Start by eating your greens. Make seafood a treat by choosing it less often and when you do, enjoy sensible portions of sustainable species that haven't been overfished or harvested using destructive methods.' – Sustainable Table

5. Buy fresh and reduce plastic pollution

'Australians dispose of 1.9 million tonnes of plastic packaging every year – that's enough to fill the MCG 9 times over! A gigantic plastic soup twice the size of France, containing over 100 million tonnes of waste has now formed in the Pacific Ocean and more than one million birds and marine animals die each year from consuming or becoming caught in plastic and other debris. Buy fresh to avoid unnecessary packaging.



Lesson 4: Sustainable Seafood (continued)

Fresh seafood will have been caught closer to where it is sold and thus have travelled a shorter distance to reach your plate.' – Sustainable Table

Did you know?

- 'Australian sardines, also known as pilchards, are caught around the coast of Australia, from Southern Queensland to Western Australia.
- On average, approximately 40,000 tonnes of sardines are caught every year in Australia, greater than any other wild-caught fish.
- Sardines are a fast growing and robust species and the stock status is classified as sustainable.
- Sardines are an incredibly healthy food option, providing a rich source of omega-3 oils. They also contain protein, iron, zinc, vitamin D and niacin.
- Despite being the most heavily fished wild caught species, and a healthy food option, only a fraction of sardines caught in Australia are used for human consumption.
- The majority is instead used to feed southern bluefin tuna, ranched in sea pens off South Australia. Most of these tuna are then sold to Japan.
- Canned sardines are eaten in Australia, however the majority of canned sardines are imported from Canada and Thailand.
- The sustainability of imported canned sardines and the bycatch that results from the fishing practices that are used cannot be certain, as the exact fisheries the sardines are sourced from are not on the label.
- Choose sardines as a healthier and more sustainable alternative to larger, less sustainable fish.
- Look for fisheries operating sustainably, for example the West Coast Metropolitan Purse Seine Fishery in Western Australia, producer of 'Fremantle Sardines'.
- Choose Australian sardines over imported canned sardines. There is no need to import what is already abundant in Australia. By eating sardines sourced from Australia you can support local industry, ensure the sustainability of the fisheries they are sourced from and avoid the environmental impact of transporting food from the other side of the world.'

– www.sbs.com.au/programs/article/2014/10/06/sardines

Use the Paddock to Plate App to find and speak to other fishers and fish farmers in Australia to find out what environmental practices they are implementing.



WHEAT

Wheat

Year 8

Stage 4



Ask students first to reflect on the *From Paddock to Plate Wheat Virtual Video Excursion*:

- What does a typical day on a wheat farm look like?
- What can they say about the paddock to plate journey of Australian wheat?
- What did they learn that they hadn't considered before?
- What else would they like to know about the wheat-growing industry in Australia?

Facts and Vocabulary - Grains

Facts about the Australian grains industry

- Wheat is the second most valuable agricultural commodity produced in Australia, after beef.
- Total wheat production was around 35 million tonnes or 57% of total grains industry tonnage.
- Australia exported 22 million tonnes of wheat in 2016–17, valued at \$6.1 billion.
- Production of grains, oilseeds and pulse crops accounted for around 29% (\$18 billion) of the total value of farm production and around 30% of the total value of farm export income in 2016–17.
- Around one quarter of Australian agricultural businesses will produce some amount of grains, oilseeds or pulses in a typical year.
- Wheat is the most important individual crop by tonnage and value. In 2016–17 wheat production was worth \$8.7 billion, making up almost half of the total value of production for the Australian grains industry.
- Australia exported 9.5 million tonnes of barley in 2016–17, valued at \$2.4 billion.
- Canola was the highest value oilseed export in 2016–17, with 3.6 million tonnes exported at a value of \$2.1 billion.
- Chickpea export volume in 2016–17 was 2.0 million tonnes, valued at \$1.9 billion.
- In 2016–17, 21% of Australia's wheat was exported to Indonesia. Vietnam, China, Japan and the Republic of Korea are other major export markets.

SOURCE: Department of Agriculture and Water Resources

- In Australia, 52,350,000 tonnes of coarse grain and wheat was produced in 2016–17 (i.e. cereal crops primarily including barley, grain sorghum, maize, oats, triticale and wheat), covering 18,469,000 hectares of land.

SOURCE: National Farmers Federation

- Australia's grains industry accounts for more than 170,000 jobs across Australia from farm to export dock.

SOURCE: State of the Grain Industry, Grain Growers Limited, 2016.

- About 65% of Australia's grain is exported, including up to 90% of that grown per annum in Western Australia and South Australia.

SOURCE: State of the Grain Industry, Grain Growers Limited, 2016.

- Australian wheat is sought after for its high flour extraction rates, bright white flour colour, low moisture content, white seed coat, fit-for-purpose protein levels and starch qualities.

SOURCE: GrainGrowers



Useful words and phrases

- Bran
- Broadacre
- Broker
- Brokerage
- Canola
- Cash market
- Coarse grains
- Cultivate
- Grist
- Commodity
- Endosperm
- Fertiliser
- Folic
- Forward contract
- FOSS machine
- Fungicide
- Germ
- Grain bank
- Hectolitre
- Herbicide
- Husk
- Kernel
- Millet
- No-till
- Quarantine
- Pesticide
- Plough
- Ring-bark
- Stubble
- Thiamin
- Trade barriers
- Variable levy
- Wheat berry
- Weighbridge
- ABARES: Australian Bureau of Agricultural and Resource Economics and Sciences
- ACCC: Australian Competition and Consumer Commission
- AEGIC: Australian Export Grains Innovation Centre
- AFIA: Australian Fodder Industry Association
- AGEA: Australian Grain Exporters Association
- AGI: Australian Grain Institute
- AGIC: Australian Grains Industry Conference
- AGIDG: Australian Grains Industry Discussion Group
- CAGR: Compound average growth rate
- CER: Clean Energy Regulator
- CFI: Carbon Farming Initiative
- ChAFTA: China Australia Free Trade Agreement
- FAO: United Nations Food and Agriculture Organisation
- GIMAF: Grains Industry Market Access Forum
- GIWA: Grain Industry Association of Western Australia
- GLNC: Grains and Legumes Nutrition Council
- GM: Genetically modified
- GPA: Grain Producers Australia
- GPPEICC: Grain and Plant Product Export Industry Consultative Committee
- GPS: Global Positioning System
- GRDC: Grains Research & Development Corporation
- JAPEA: Japanese Australia Economic Partnership Agreement
- KAFTA: Korea Australia Free Trade Agreement
- OGTR: Office of the Gene Technology Regulator
- WEA: Wheat Exports Australia
- WIAT: Wheat Industry Advisory Taskforce
- WIS Account: Wheat Industry Special Account
- WQA: Wheat Quality Australia
- WTO: World Trade Organisation



Lesson 5

Wheat, Weeds and Adaptation

Themes

Environment	Conservation	Climate change	Food security
Biodiversity	Biosecurity	Soil health	Pest and weed control

Wheat

Year 8

Stage 4

ACHGK051

The human causes and effects of landscape degradation

ACHGK052

The ways of protecting significant landscapes



Getting started

EVALUATE Peter's views on the value of the environment, taking into consideration that his livelihood depends on the health of the plants, soil, air and water.

Students RESEARCH measures in place to protect this environment, such as regulations and guidelines for practice (source materials below will assist).

In groups or pairs, they DISCUSS how these practices link to changing concerns about environmental stewardship, sustainability and a changing climate.



"When we're growing grain now, we don't burn paddocks anymore. All your stubble is retained so you minimise your wind erosion, you're not putting greenhouse gases into the air from burning stubble, it provides a cover for the crop when it emerges and helps maintain soil moisture."

(5:38 – 5:59)



"We use a minimum of sprays. We try not to use too many insecticides or fungicides."

(6:20 – 6:26)



"We planted 120,000 trees over the last four years as wind breaks and to replace some of the bush which has reached the end of its lifecycle and is dying anyway."

(7:12 – 7:21)



"To deal with climate change and global warming, we've had to change our farming practices over the last 20 years. Before minimum till it was all plough, work back, seed, sometimes you'd have to cultivate a second time. Now the whole operation is done in one pass. A lot of it is done dry before the season breaks so we can maximise our water use."

(7:23 – 7:47)



Lesson 5: Wheat, Weeds and Adaptation (continued)

Recommended source material:

[Government] Projects include:

- \$19.3 million to support cane farmers to move beyond industry best practice for nutrient, irrigation, pesticide and soil management, with a particular focus on improved fertiliser budgeting.
- \$23.7 million for improve grazing land management to reduce erosion losses to the Reef, with emphasis on matching sustainable stocking rates to long-term sustainable carrying capacity of grazing properties.
- \$7.1 million to maintain water quality improvement momentum in the Reef catchment grains, dairy and horticulture industries, with the highest priorities being soil retention in grain cropping, and nutrient and ground cover management in banana cropping

“Farmers in the Reef catchment have already made a positive contribution towards meeting water quality targets by reducing fertiliser and soil runoff, and reducing pesticide loss by over 30 per cent,” Mr Entsch said.’

– \$50 million to help farmers continue to protect the Great Barrier Reef, The Hon. Greg Hunt MP, Minister for the Environment, April 2016: www.environment.gov.au/minister/hunt/2016/mr20160426.html

‘Technological and scientific advancements to protect the environment have included:

- the introduction of the Cactoblastis moth, to control spread of the Prickly Pear cactus
- the introduction of the myxoma virus (myxomatosis), and more recently the rabbit calicivirus, to control rabbit numbers
- the implementation of holistic systems such as integrated pest management and cell grazing, and
- the use of satellite positioning systems to assist in land management by, for example, controlled traffic farming to minimise soil compaction.’

– Australian Bureau of Statistics, Year of the Farmer: www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Farming%20in%20Australia~207

Pest populations



Students undertake RESEARCH to find out how our changing climate can influence the number of pests and weeds that a grain farmer needs to deal with and therefore create uncertainty over the yield potential of a crop.

They can begin with the sources below, but should also find data and evidence in other authoritative sources.



“If we didn’t use fungicides and insecticides you can end up with small grain, you can have rust which can wipe a crop out, insects which can do a lot of damage to seedlings and to maturing crops. They’ll ring-bark the stalks and that stops moisture getting to the grain to fill the grain.”

(6:00 – 6:19)



Lesson 5: Wheat, Weeds and Adaptation (continued)

Recommended source material:

‘Over the past decades, climate change has induced transformations in the weed flora of arable ecosystems in Europe. For instance, thermophile weeds, late-emerging weeds, and some opportunistic weeds have become more abundant in some cropping systems. The composition of arable weed species is indeed ruled by environmental conditions such as temperature and precipitation. Climate change also influences weeds indirectly by enforcing adaptations of agronomic practice. We therefore need more accurate estimations of the damage potential of arable weeds to develop effective weed control strategies while maintaining crop yield.’

– *Impact of climate change on weeds in agriculture: a review* by Kristian Peters, Laura Breitsameter & Bärbel Gerowitt, *Agronomy for Sustainable Development*, October 2014, Volume 34, Issue 4, pp 707–721

‘Weeds are one of the main threats to biodiversity and agriculture but under climate change, management of this threat will be an increasing challenge in two ways.

- Firstly, the suite of weed species will change.
- Secondly, some weeds will become more invasive.

The main drivers for climate change impacts on weeds include increased temperatures, changed rainfall, increased CO₂ levels, more extreme weather, more frequent frosts, changed phenology and changed land use. The rate of response of invasive plants and weeds is expected to be faster than for other plants, including native species and crops. Secondly, climate change is likely to foster the appearance of a new set of weed species. One of the main effects of climate change is its influence on species’ distributions. There is extensive modelling of species distributions for southern Australia, mostly indicating a southern shift. There is a need for increased species modelling for central and northern Australia. A major adaptation response to climate change is increased landscape connectivity, but this presents a major opportunity for increased weed invasion. Adaptation responses include quarantine and filtering methods to monitor species displacement. The national level of biosecurity threat is not expected to increase with climate change. Instead, the main threat of species migration is from neighbouring regions in Australia. Novel ecosystems are already a reality in the Australian environment. The new species assemblages due to changed distributions of both alien and native species will lead to the formation of novel ecosystems. A new management approach will be needed.’

– AdaptNRM, a national initiative – Weeds and Climate Change: Supporting weed management adaptation, Technical Guide (PDF): http://adaptnrm.csiro.au/wp-content/uploads/2014/08/Adapt-NRM_M2_WeedsTechGuide_5.1_LR.pdf



Lesson 5: Wheat, Weeds and Adaptation (continued)

Recommended source material (continued):

'The characteristic of weeds to be able to respond rapidly to disturbances such as climate change, may give them a competitive advantage over less aggressive species. The impacts of climate change on single species and ecosystems are likely to be complex. Climate change, as well as the interactions between climate change and other processes (such as changes to land use and to fire regimes), may also turn some currently benign species (both native and non-native) into invasive species and may lead to sleeper weeds becoming more actively weedy. Climate change is expected to increase the risk of invasion by weeds from neighbouring territories. Climate change may also favour weeds that have already established in Australia but are currently restricted in range, enabling them to increase their range. As climatic zones shift, weeds that are capable of rapid dispersal and establishment have the potential to invade new areas and increase their range. Weeds that are well-suited to adapt to the impacts of climate change may not only fill gaps left by more vulnerable native plants, they may have an even greater effect by altering the composition of ecosystems and their integrity. In fact, climate change may favour certain native plants to such an extent that they then become weeds. Increasing levels of carbon dioxide may also have an impact on plant growth rates, which may cause changes in weed spread. Research into the potential impact of climate change on invasive species indicates that some weed species and pest animals may benefit from climate change. The Australian Institute of Alpine Studies found that climate change in the Australian Alps is expected to benefit some weed and pest animal species which may be currently excluded from higher altitudes due to the severe environmental conditions found at these altitudes.'

– Australian Department of the Environment – Factors Influencing Weeds: www.environment.gov.au/biodiversity/invasive/weeds/weeds/why/factors.html

'AUSTRALIA'S most comprehensive analysis of the cost of weeds in cropping systems has shown that the overall annual cost to WA grain growers is \$927 million or \$117 a hectare. The Grains Research and Development Corporation (GRDC) commissioned report shows that growers are investing heavily in weed management and, despite increasing levels of herbicide resistance, in-crop weed populations are mostly being kept low. CSIRO farming systems senior research scientist Rick Llewellyn, the lead author of the report, said that while the study identified important differences between regions and agro-ecological zones, key results at a national level included:

- The overall cost of weeds to Australian grain growers is \$3.3 billion annually
- Weeds are costing Australian grain growers on average \$146 per hectare in expenditure and yield losses
- Average expenditure on weed control, including herbicide and non-herbicide practices, is \$113/ha



Lesson 5: Wheat, Weeds and Adaptation (continued)

Recommended source material (continued):

- Yield losses due to weeds amounts to 2.76 million tonnes of grain
- The most expensive weeds in terms of total yield losses are annual ryegrass, wild radish and wild oats, with brome grass being a notable major weed that is increasingly costly.

Dr Llewellyn said the costs of yield losses due to weed competition (\$708m nationally) were much lower than total weed management costs (\$2.6b).'

– Study reveals huge cost of weeds, Farm Weekly, 20 April 2016: www.farmweekly.com.au/news/agriculture/cropping/grains/study-reveals-huge-cost-of-weeds/2752271.aspx

Teacher resource:

- Students might also use the Paddock to Plate App to find and speak to grain growers in Australia to find out what environmental practices they are implementing to protect the environment that their grain grows in.
 - App Store: <https://itunes.apple.com/us/app/paddock-to-plate/id1012377466?mt=8>
 - Google Play: <https://play.google.com/store/apps/details?id=com.mavinapps.produce>



Lesson 6

Fire on the Land

Themes

Bushfires	Natural disasters	Environment	Community
Technology	Volunteers	Safety	Soil health

Natural hazards

Explain the terms 'biotic' and 'geomorphic'.

- biotic: relating to the living things of an environment
- geomorphic: relating to the landscape features and the earth's surface

In pairs, ask students to DISCUSS and DECIDE: is bushfire a biotic or a geomorphic event?

Students INVESTIGATE the causes and spatial distribution of bushfires as an example of a biotic hazard that affects a landscape and the living things within that environment. They use data and maps to assist with their investigation – several sources are provided below under Teacher Resources.

Prevention and preparedness

Students RESEARCH how the application of principles of prevention, mitigation and preparedness minimise the harmful effects of bushfires.

They GATHER relevant data from a range of primary sources, for example, from observation and annotated field sketches, surveys and interviews, or photographs, about the ways to protect significant landscapes.

They may use Geoscience Australia's online tools to find and collect data, as well as other authoritative sources.

- Geoscience Australia – Hazards: <https://www.ga.gov.au/scientific-topics/hazards>
- Geoscience Australia – Online Tools: <http://www.ga.gov.au/data-pubs/online-tools>

Grain and fires



"To deal with climate change and global warming, we've had to change our farming practices over the last 20 years. Before minimum till it was all plough, work back, seed, sometimes you'd have to cultivate a second time. Now the whole operation is done in one pass. A lot of it is done dry before the season breaks so we can maximise our water use."

(7:23 – 7:47)

Wheat

Year 8

Stage 4

ACHGK053

The causes, impacts and responses to a geomorphological hazard

ACHGS056

Collect, select and record relevant geographical data and information, using ethical protocols, from appropriate primary and secondary sources

ACHGS057

Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies

ACHGS058

Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate

ACHGS059

Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends and infer relationships





Lesson 6: Fire on the Land (continued)

With what they understand about the needs of wheat farming (such as resources including soil, water, climate and weather) from the *From Paddock to Plate Wheat Virtual Excursion*, students **SUGGEST** at least three ways in which bushfires can have an impact on wheat farms and grain production. They may do this in groups and share with the class.

Remind students that growing grain is the livelihood of many farmers in Australia. Prompt them to think beyond loss of property to effects such as decreased biodiversity, transport disruptions, smoke damaged grain, and changes to the water and soil of the region.

Ask students to **CONSIDER** what happens to the soil after a bushfire. They **RESEARCH** what effect the heat, smoke, carbon and debris has on the soil biota. Ask students to estimate and then find out how many seasons would it take, on average, for the microbiota of the soil of a farm to recover after a grassland fire? (Is it longer or shorter than students expected?)

Recommended source material:

'The impact of fires on vegetation and wildlife is obvious. Less obvious is the impact of fires on soils. What happens to the soil life, and to soil nutrients? Italian research found that soil biodiversity recovers quickly after fire but soil fungi take longer to recover than bacteria. Nutrient levels and soil organic matter both increase after fire. Spanish research showed a significant increase in soil pH, carbon and nutrients immediately after a prescribed grass fire. A year later, pH and total carbon had returned to pre-fire levels, nitrogen and phosphorus were above pre-fire levels, but potassium was lower. Spanish laboratory studies found that heating soils up to 400 degrees C enriches available nutrients and stimulates bacteria even without ash. However, temperatures above 400 degrees have a detrimental effect on microorganisms until vegetation recovers. One of the greatest issues for soil recovery after fire is heavy rainfall. The combination of fire and torrential rain can prevent revegetation, leading to land degradation which may be permanent. While vegetation regrowth usually reduces surface water flow and soil erosion, US research has found that pine regrowth on fire-affected soils is associated with water-repellent soils, so forest establishment may not be the best way to rehabilitate some burnt sites. Research into the impact of fire on soils is difficult. Scientists need to study sites that have pre-fire data already collected so they can compare the post-fire soils, but it is hard to anticipate where fires might strike. Findings in one region or country may not be applicable to other areas due to differences in climate, vegetation cover and land management. However, the limited research that is available shows that fires can have profound effects on the soil ecosystem, leading to short and long term changes.'

– NSW Government



Lesson 6: Fire on the Land (continued)

Recommended source material (continued):

'He says the fire had a huge impact on his soil which he'd spent years developing as a no-till farmer. "The immediate affect has just been loss of cover which protects the soil. The long-term effect is whether we'll see greater need for some fertiliser or something because that stubble's not there to break down over the next couple of years." He says he's now had to sow deeper than usual and has also changed his crop rotation to adapt to the conditions. "I had a pretty big program planned for faba beans but past experience show faba beans don't like growing much in bare soil. So we've cut that program in half and upped our canola to compensate for that."

– *Bushfire affected farmers begin sowing on a moonscape* by Lauren Waldhuter, ABC Rural, 5 May 2014: www.abc.net.au/news/2014-04-30/bushfire-sowing/5420390

'Strathbogie Mayor Debra Swan said there was a view the damage was not extensive, with only four houses lost in the 5085ha blaze. But many farmers had lost livelihoods after the fire devastated crops, pastures and stock. "We all need to be more conscious of what a farming community loses in a fire," Cr Swan said. "It's a full year's income for some people. It's not always recognised as important, but it is important. It's devastating to lose a house but it's also devastating to lose crops, pasture and stock."

– *Farmers in Victoria's north count cost of devastating bushfires* by Ashley Argoon, Herald Sun, 21 December 2014: www.heraldsun.com.au/news/victoria/farmers-in-victorias-north-count-cost-of-devastating-bushfires/news-story/b291af074fae51ce32f971c4723e5b3c

Teacher resources:

- ABC News – What a Century of Bushfire Data Teaches Us About How to Save Lives this Summer: <https://www.abc.net.au/news/2018-12-27/bushfire-history-australia-data-saving-lives/10606144>
- Australian Bureau of Statistics – Bushfires: <http://www.abs.gov.au/ausstats/abs@.nsf/0/cb3f2e90ba779d3ca256dea00053977>
- CSIRO Bushfire Research: <https://www.csiro.au/en/Research/Environment/Extreme-Events/Bushfire/Bushfire-research>
- Data South Australia – Bushfire Data Sets: <https://data.sa.gov.au/data/dataset?tags=bushfire>
- Students could also find local farmers using the Paddock to Plate App. If time permits, visit these farms to assist collecting data as part of the research task.
 - App Store: <https://itunes.apple.com/us/app/paddock-to-plate/id1012377466?mt=8>
 - Google Play: <https://play.google.com/store/apps/details?id=com.mavinapps.produce>