GEOGRAPHY BULLETIN

SUSTAINABLE BIOMES

The Geography Teachers' Association of New South Wales Inc.

Volume 51 No 1 2019

IN THIS ISSUE:

PROJECTS • REPORTS • RESOURCES • ARTICLES • REVIEWS

EXECUTIVE 2019

GEOGRAPHY BULLETIN

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ANNUAL MEMBERSHIP (Subscriptions include GST)

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Front & back cover: Lachlan River at Inglewood Bridge, Gunning
Image source: Wikimedia Commons

The Geography Bulletin is a quarterly journal of The Geography Teachers' Association of New South Wales. The 'Bulletin' embraces those natural and human phenomena which fashion the character of the Earth's surface. In addition to this it sees Geography as incorporating 'issues' which confront the discipline and its students. The Geography Bulletin is designed to serve teachers and students of Geography. The journal has a specific role in providing material to help meet the requirements of the Geography syllabuses. As an evolving journal the Geography Bulletin attempts to satisfy the requirements of a broad readership and in so doing improve its service to teachers. Those individuals wishing to contribute to the publication are directed to the 'Advice to contributors' inside the back cover. Articles are submitted to two referees. Any decisions as to the applicability to secondary and/or tertiary education are made by the referees. Authors, it is suggested, should direct articles according to editorial policy.

GEOGRAPHY BULLETIN

Volume 51, No1 2019
EDITOR: Lorraine Chaffer

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EDITORIAL

Welcome to the first edition of the Geography Bulletin for 2019. This edition has a content focus on Stage 5 Sustainable Biomes. A big thank you to all contributors.

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EDITION 2 OF THE GEOGRAPHY BULLETIN WILL FOCUS ON URBAN PLACES AND LIVEABILITY.

Upcoming GTA NSW & ACT events

- **HSC Exam Preparation Lectures**
  - Newcastle Thursday 13 June
  - Sydney Tuesday 18 June
  - Coffs Harbour Friday 28 June
- **Term 2 Webinar program**
  - Monday 13 May – Water in the World (Louise Roberts, Sydney Water)
  - Thursday 30 May – Ecosystems at Risk: Tundra Environments (Louise Swanson)
- **Regional Conferences**
  - Kiama – Thursday 30 and Friday 31 May
  - Coffs Harbour in Term 4 (date tbc)
- **Skills Workshops**
  - Warwick Farm (September date tbc)
  - Potts Point (September date tbc)
- **Online Learning Geography Concepts 101** – At your convenience

Lorraine Chaffer, Editor

Australian Geography Teachers Association Conference

This event is being held on the Gold Coast, Tuesday 1 – Friday 4 October with presenters from all states.

Don't miss this opportunity to meet and share with fellow geographers from across Australia. Conference website – http://www.agta2019.com.au/index.php

GTA NSW & ACT is giving four lucky teachers the opportunity to apply for a sponsorship that will pay for the full registration. (See the flyer in this issue and on the GTA Website).

Congratulations: Competition winners

GTANSW & ACT congratulate the winners of the inaugural **National Geospatial Information Competition** run in late 2018. NSW students took home the first and second prizes from entries from schools across Australia.

First place was Elizabeth Peabody and Micah Edwards who were in Year 7 at Nowra Christian College in NSW last year. They completed a **storymap** called '**Using spatial technology to optimise nest box placement**'. The judges felt that they used data they had collected, geospatial tools and geospatial information really well to outline their problem, analyse it and draw a conclusion. As part of their prize, Lizzie, Micah and their teacher will attend the Locate19 Conference in Melbourne, including the Asia-Pacific Spatial Excellence Awards Gala Dinner to showcase their work to the industry and to see how geospatial tools can be used in the real world.

Second place was Bede Taylor and Tom Abbott who were in Year 9 at Barker College in NSW last year. Their video, '**Solving homelessness in NSW using geospatial technologies**', examined homelessness in Sydney and across NSW.

The 2019 Competition will be announced soon! For more information on the competition, or on Spatial Science as a career path for young people, please visit the Geospatial Science website.

EDITORIAL

Geography Teachers Association of NSW & ACT

REGIONAL CONFERENCE KIAMA

OBSERVE, INQUIRE, CREATE

SPECIAL OFFER – first 40 delegates to register for the conference have the option to attend, at no additional charge:

- The pre-conference dinner – **Wednesday 29 May, 6.00pm**
- Kenny Escapes: Berry wine tasting tour and lunch – **Saturday 1 June, 11.00am – 5.00pm**

Thursday 30 & Friday 31 May 2019

The GTA Regional Conference in the Field: Observe, Inquire, Create will be held over two days at the luxurious Sebel Harbourside, 31 Shoalhaven St, Kiama.

Day One of the conference – the first session updates teachers on current research on the role of geographic fieldwork in improving and enriching student outcomes. The second session involves teachers in practical fieldwork activities in coastal, rainforests environments and urban areas where teachers will select and apply strategies to develop geographic knowledge and skills that can be implemented with their students.

Day Two – teachers work in small groups to broaden their knowledge and improve their teaching practice by selecting and using the knowledge and skills from the previous day's fieldwork activities to create a sequence of fieldwork activities that will engage students in fieldwork and enhance geographic knowledge and skills.

Regional Conference registration opens Friday 29 March on the GTA website – www.gtansw.org.au

Early Bird member rate $460 or non-member $480

This event is proudly supported by

NSW GOVERNMENT

Destination NSW

The Geography Teachers' Association of NSW & ACT

SPONSORSHIP OFFER

GTA NSW & ACT will be sponsoring four NSW teachers to attend the AGTA Conference on The Gold Coast during October 2019

About the conference

The Australian Geography Teachers Association conference takes place on Queensland's Gold Coast from Tuesday 1 to Friday 4 October 2019.

The 2019 conference theme is 'The Innovative Geographer'. In an ever changing world, the study of Geography has become increasingly important. The technologies needed to collect, manage and represent our world are constantly changing. The proliferation of 'big data' and the everyday use of spatial technologies means that Geography teachers need to innovate in the classroom to ensure their students have the 21st century skills they will need to be successful beyond high school.

The 2019 AGTA conference program will provide opportunities for teachers from across Australia to share and reflect on their own innovations in the Geography classroom.

For further information about the conference – www.agta2019.com.au & agta.asn.au/Conferences/

About the GTA Sponsorship

The sponsorship will pay full registration for the main conference from 1 – 4 October 2019.

To be eligible entries need to come from teachers in Northern NSW who teach in GTA MEMBER SCHOOLS or are INDIVIDUAL GTA MEMBERS. (By definition – from Sawtell / Coffs Harbour area to the NSW – Queensland border).

Conditions of sponsorship

Successful participants will be required to submit an article for publication in the GTA *Geography Bulletin* stating how they benefited from the experience and how they intend to integrate what they have learned into their Geography Teaching Programs.

Applications open Monday 22 April and close on Friday 24 May. Submit your application HERE

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2019 HSC PREPARATION LECTURES FOR YEAR 12 STUDENTS & TEACHERS

Once again this year, GTA NSW has organised lectures for HSC Geography students and teachers. The presenters are experienced educators and HSC markers. Sessions cover: Ecosystems at Risk, Urban Places, People and Economic Activity and Geography skills and exam advice.

DATES AND LOCATIONS

Thursday 13 June	**Newcastle: Callaghan Secondary College** (Jesmond Campus, Janet St, Jesmond)
Tuesday 18 June	**Sydney: NSWTF Conference Centre** (Reservoir St, Surry Hills)
Friday 28 June	**Coffs Harbour: John Paul College** (Hogbin Drive, Coffs Harbour)

TIME

9.30am – 3.00pm, registration from 9.00am

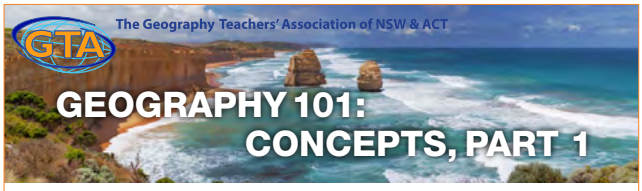
COST (inc GST)

$40 per student for member schools/teacher
$60 per student for non-member schools/teacher

Teacher attending with students admitted FREE. Teachers attending with students will receive a link to lectures presented on the day for distribution to students after the event.
Teacher attending without students – $80 member and $100 non-member

ONLINE REGISTRATION – CLICK HERE

Supply a list of attendees with your school's registration • Registration closes one week prior to each event • Students are encouraged to bring writing equipment and paper or tablet devices to mind map key concepts and advice.



A flexible anywhere, any time online learning opportunity through Open Learning

Geographical concepts are a foundation for teaching Geography in NSW. This professional development course, created by Dr. Paul Batten on behalf of the GTA NSW & ACT, examines the seven key concepts from the Australian Curriculum Geography and NESA Geography Syllabus K–10. These concepts are: place, space, environment, interconnection, scale, sustainability and change.

The purpose of the course is to build teachers' understanding of these core concepts. By completing the learning activities participants will demonstrate their capacity to use three of the concepts – place, space and environment – to create engaging Geography lessons.

Skills developed in this course include: applying knowledge of the content and teaching strategies of Geography to develop engaging teaching activities (NESA Standard 2.1.2), providing opportunities for ATSI respect and understanding (NESA Standard 2.4.2) and contributing to collegial discussions to improve professional knowledge and practice (NESA Standard 6.3.2).

The course is designed for flexible delivery, where participants can start, progress and finish at times convenient to them. The collaboration is in a 'pay it forward' style, where participants engage with previous contributions and contribute themselves – learning in the process, but also adding to the galleries of exemplars and case studies for future participants to review.

Cost: $90 Register at https://www.openlearning.com/ptc-nsw/courses/geography-101/
For further information about this course contact – gta.elearning@gmail.com

NSW GOVERNMENT

Geography Teachers Association of NSW & ACT, through the Professional Teachers' Council NSW – is endorsed to provide the NSW Education Standards Authority (NESA) Registered Professional Development for teachers accredited at Proficient, Highly Accomplished, and Lead levels.

Completing the **Geography 101: Concepts, Part 1**, on **29 October 2018 – 29 October 2019** will contribute **3 Hours** of NSW Education Standards Authority (NESA) Registered PD addressing 2.1.2; 2.4.2; 6.3.2 from the Australian Professional Standards for Teachers towards maintaining Proficient Teacher Accreditation in NSW.

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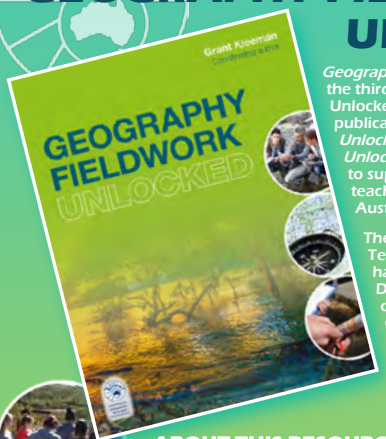
NEW TO THE AGTA GEOGRAPHY UNLOCKED SERIES

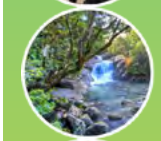
GEOGRAPHY FIELDWORK UNLOCKED



Geography Fieldwork Unlocked is the third book in the Geography Unlocked series. Like companion publications – *Geography Skills Unlocked* and *Geography Literacy Unlocked* – the resource seeks to support and enhance the teaching of Geography in Australian Schools.

The Australian Geography Teachers Association (AGTA) has published the book with Dr Grant Kleeman, one of Australia's leading Geography educators, acting as coordinating author.

→ NOW AVAILABLE



ABOUT THIS RESOURCE

Geography Fieldwork Unlocked **features 34 inquiry-based fieldwork activities developed by a team of experienced Geography educators**

Section 1 of the book introduces the reader to inquiry-based fieldwork. It also provides guidance in developing fieldwork action plans, research methodologies, and data collection tools and approaches. It also provides guidance on the presentation and communication of fieldwork findings.

Section 2 features nine fieldwork activities for primary students (Years F/K–6). Each of these activities has been designed to develop students' conceptual understanding and the skills associated with inquiry-based learning.

Section 3 showcases 25 fieldwork activities aligned to the topics studied by students in Years 7–10.

Each fieldwork activity is framed by one or more inquiry questions. They also feature: a statement of expected learning; a list of the equipment needed to successfully complete each fieldwork activity; a short introduction; background information that contextualises student learning; pre-fieldwork activities; and detailed step-by-step instructions on how to complete each fieldwork task.

Brock Rowe Award 2019

Presented to Glen Halliday, Observatory Hill Environmental Education Centre

The Brock Rowe Award, an annual award for excellence in teaching geography in schools, is granted jointly by the Councils of the Geography Teachers' Association of NSW & ACT (GTANSW & ACT) and the Geographical Society of New South Wales Inc. (GSNSW), biennially, to persons who have demonstrated consistently, over a period, excellence in the teaching of geography in schools.
Our congratulations to Glen Halliday from Observatory Hill Environmental Education Centre, a worthy recipient of the 2019 Brock Rowe Award.

Award citation

Glen Halliday has been an inspiration to many teachers and students of Geography from regional and metropolitan New South Wales, across primary and secondary stages of schooling.

For almost two decades, Glen has led and modelled change in the development of teaching practice, resources, and fieldwork focused case-studies at Observatory Hill Environmental Education Centre. Within the last five years, Glens' excellence in the teaching of Geography has been acknowledged through his promotion from Teacher to Principal of the Centre, and through his active involvement in multiple programs across the network of Environmental and Zoo Education Centres including leading teacher professional learning around Sustainability and mentoring students who are participating in Environmental Leadership workshops.

Glen has a deep knowledge about the processes which shape the urban environment, and he actively seeks to extend this understanding through his personal interest in history and civic responsibility evidenced by a love of visiting museums and art exhibitions, participating in community round-table discussions, and engaging in dialogue with government, community and business stakeholders. Glen draws on his knowledge and experience to purposefully construct and build on student and teacher understanding about the real-world urban context, and in so doing brings urban environments to life by emphasising the importance of perspective and encouraging the development of a personal appreciation for individual and collective roles in shaping the physical urban surrounds and sense of community. Glen also focuses on extending student and teacher understanding about urban environments through the development of meaningful and authentic fieldwork which utilises a range of geographic tools and skills, industry experts, and literacy and numeracy strategies. The Stage 6 Geography case-studies of Pyrmont, Green Square and Barangaroo are exemplar models of the rich learning experiences and set of supporting resources that Glen has developed throughout his time at Observatory Hill Environmental Education Centre.

Glen generously and regularly shares his knowledge through school and classroom visits, presentations at GTANSW and CoLab conferences, and through collaboration and research across Science, History and Technology learning areas to develop Kindergarten to Year 12 active learning, in-the-field experiences.

Amongst his peers, Glen is known for his ability to adapt programs to cater for a diverse range of students and teachers. He is highly regarded within the community of Geography teachers and has consistently demonstrated excellence in the teaching of Geography across a variety of contexts.

Congratulations to Glen Halliday, Principal of Observatory Hill Environmental Education Centre, a worthy recipient of the 2019 Brock Rowe Award.

Geoff Conolly Award 2018

Presented to Lynne Acworth, for her meritorious contribution to the GTA NSW & ACT *Geography Bulletin,* Vol 50 Issue 4 2018

Article entitled: An Australian NGO: The Catherine Hamlin Fistula Hospital

Lynne recently returned from a visit to Ethiopia to visit the Catherine Hamlin Fistula Foundation.

Above:. Lynne with patients

Above: Student midwives

'I was struck by the friendliness of the patients and it was easy to forget the trauma they had faced and most probably the death of their baby. They were so grateful for everything that was done to heal them and enthusiastically posed for photographs. We heard from the Acting CEO that there is a clear vision for the future, including an extension to the hospital building which has already been started. There was a class in progress where patents were being taught how to make bags for sale in the hospital shop. It was here that we bought so many of the patients' handmade products, which included pottery, embroidered cloth and scarves.

At the rehabilitation centre, Desta Mender, we learnt of the impressive program whereby longer-term patients are helped to put together a business plan and receive a one-off grant. They are mentored and have continuing support with their venture. The practicalities of restoring their dignity were inspirational.

Perhaps the most heart wrenching yet heart-warming visit was to a rural clinic. These clinics are government owned but now over sixty are staffed by a Hamlin midwife. There were two mattresses in the labour waiting area. In the main clinic, two beds, a birthing bed, no running water and only rudimentary medicine. Yet there was a woman who had given birth the day before and needed intervention with a vacuum suction machine. The fact that she was attended by a Hamlin midwife and that the instrument had been bought by Hamlin probably saved the life of her baby and prevented an obstetric fistula.'

Lynne Acworth

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 Students:	ESSENTIAL CONTENT DOT POINTS OUTCOMES *Key inquiry questions *Syllabus* *Key inquiry questions * Non-syllabus*	CONTENT IDEAS 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. *What are the main characteristics that differentiate the world's biomes?* *How does primary productivity vary between biomes?* *Challenge question: Should biome maps include anthropogenic biomes?* **GE5-1, GE5-7, GE5-8**	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. ** It is important to understand the factors that influence food production to understand the challenges.*	Investigate environmental, economic and technological factors that influence agricultural yields in Australia and across the world. *Why are some parts of the world able to produce higher yields from agricultural activities than others?* Investigate environmental challenges to food production for Australia and other areas of the world. *What challenges limit the potential of agriculture to increase food production?* **GE5-2, GE5-7, GE5-8**	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. *How do people use and alter biomes for agricultural production?* *What are the consequences of biome alteration?* **GE5-3, GE5-5, GE5-7, GE5-8**	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. *Can the world's biomes sustainably feed the world's population?* *What strategies can be used to increase global food security?* *Challenge Question: Can all food production systems be more sustainable?* **GE5-1, GE5-2, GE5-3, GE5-5,GE5-7, GE5-8**	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.

NSW Education Standards Authority. Source: https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/hsie/geography-k-10/content/1191

BIOMES

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 – e.g. rubber, opium, biofuel.

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

Technological innovations – new technologies that change farming practices and increase farm yields e.g. 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.

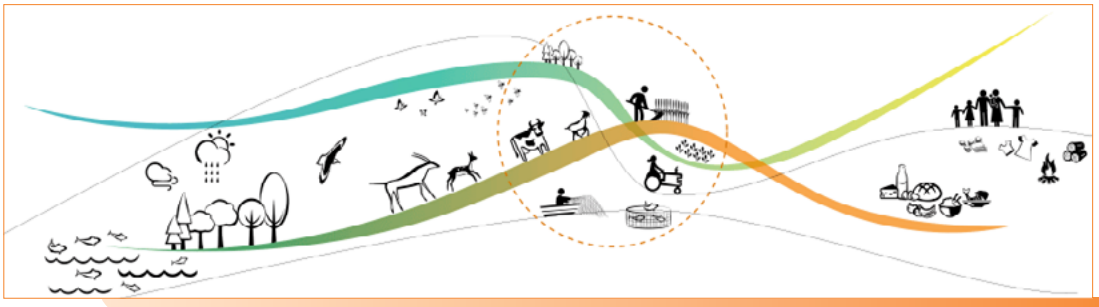
Population projection – a picture of what the future population may look like, based on knowledge of the past and current fertility, mortality and migration patterns and trends.

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 biodiversityloss, 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
- Introduction to biomes (visual stimulus) – https://www.youtube.com/watch?time_continue=5&v=hIy0ZlyPPDg
- 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

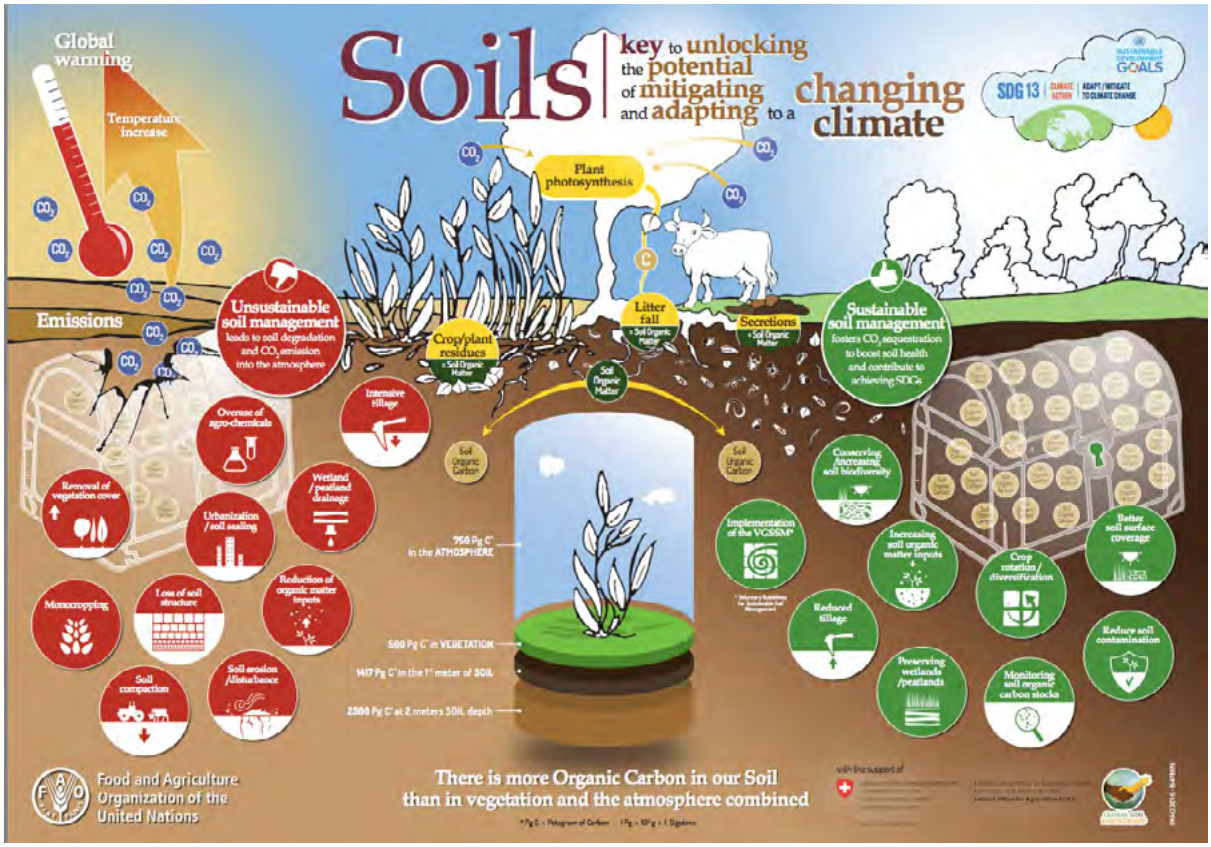
- Oxfam: Which biomes are able to produce food – https://www.oxfam.org.au/get-involved/how-schools-can-get-involved/classroom-resources/food-4-thought-2/food-4-thought-geography/worksheet-2-which-biomes-are-able-to-produce-food/
- Where the world's food comes from – https://www.dailymail.co.uk/sciencetech/article-3643363/How-far-food-travelled-Interactive-map-shows-world-s-food-comes-from.html
- Sustainability: what does it mean? – https://youtu.be/_5r4loXPyx8
- Biomes and sustainability – https://smithbiome.weebly.com/sustainability.html
- Climate smart agriculture – https://www.youtube.com/watch?v=lUdNMsVDIZ0
- 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-XBAjq6IXO5ej6_JHRF1iQIM2&index=8

Sustainable agriculture

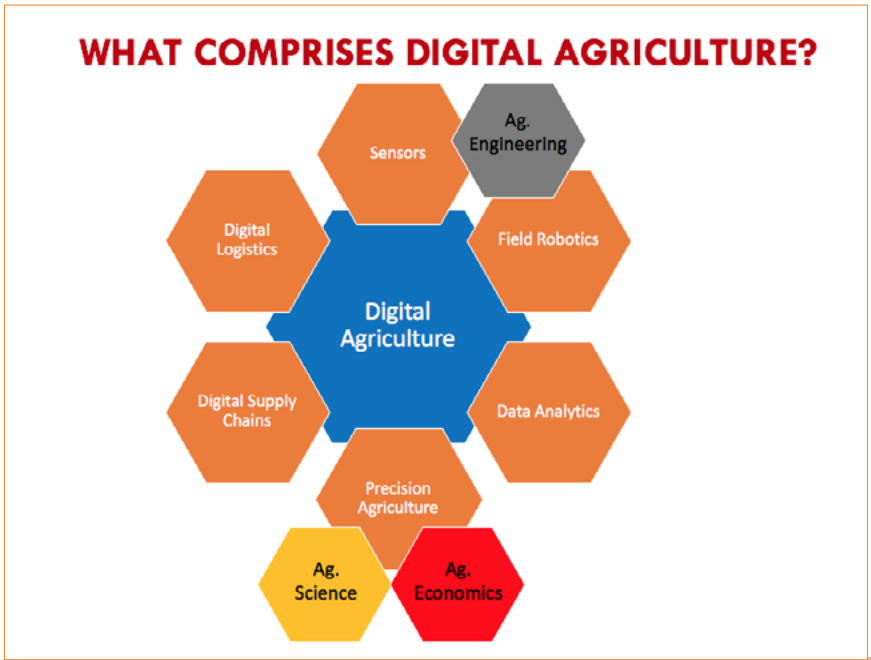
- FAO Sustainable Food and Agriculture – http://www.fao.org/sustainability/frameworks-approaches/en/
- A new beginning for the Australian Landscape – https://www.youtube.com/watch?v=tj4nwzscuZ0
- Innovative cattle stations in Australia – https://www.youtube.com/watch?v=pdISOUfd4fo
- Regenerating the 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
- 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

Food security

- Food security – https://www.youtube.com/watch?v=VCYeLuURxRM&t=8s
- Food security – 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
- 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



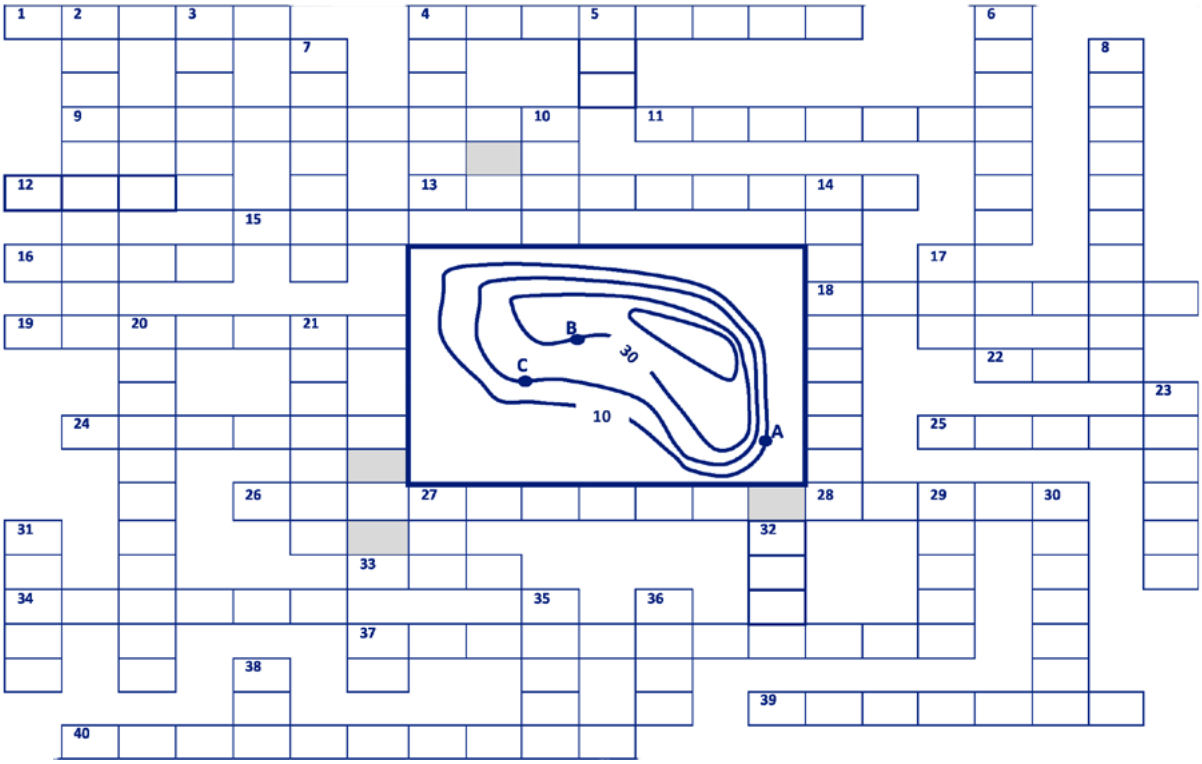
Above: Sustainable farming maintains soil services. Source: FAO via Twitter



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

Sustainable Biomes crossword – A student activity by David Proctor



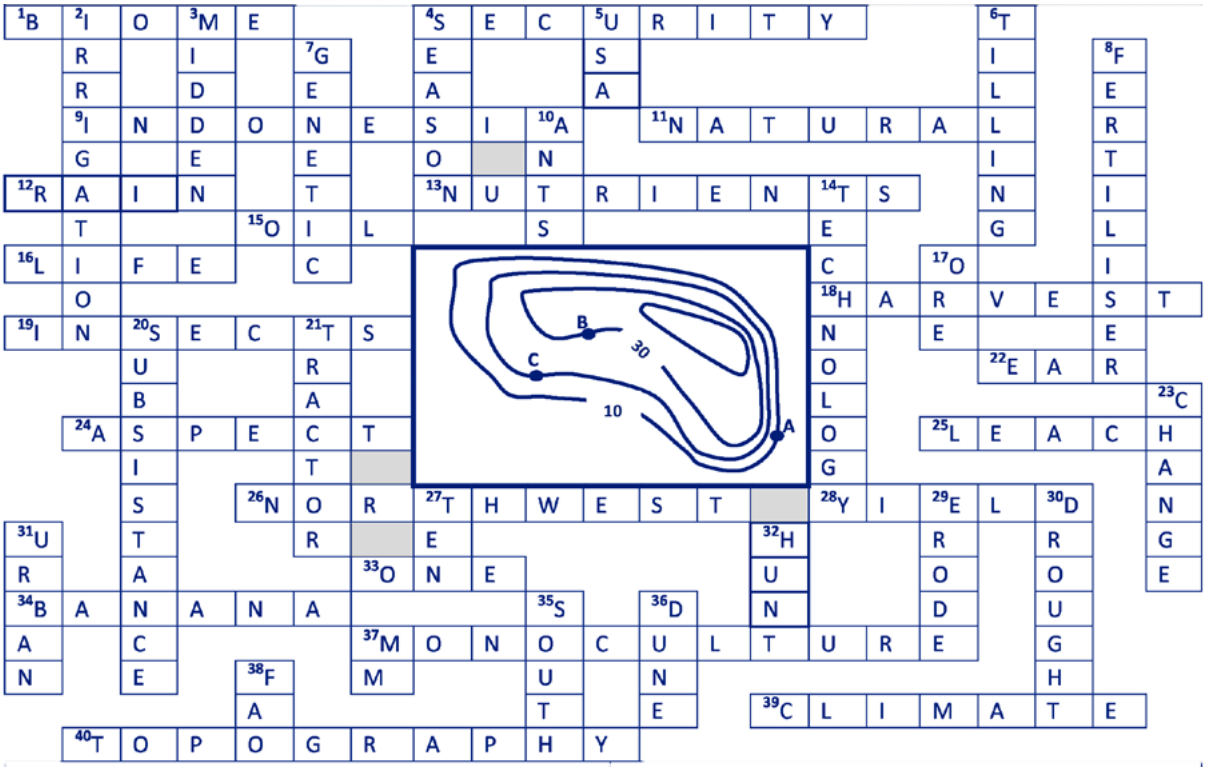
Across

1. Major terrestrial community based on similar vegetation; we should manage their use sustainably (B)
4. Food _____: enough food to meet dietary needs in a particular location (S)
9. A country where rice is grown using terraced farming and modern technology as well (I)
11. Not the built environment (N)
12. Not enough of this and a crop may not be successful; droughts are long periods without this (R)
13. These cycle within an ecosystem; found in foods they help your body to grow and develop (N)
15. A non-renewable resource extracted from the environment – can cause significant pollution (O)
16. Your _____ expectancy can be greatly reduced if you do not have enough of the right foods to eat (L)
18. The process or time of gathering crops (H)
19. A more sustainable source of protein than beef; mostly eaten in Asia, would Australian's eat them? (I)
22. The part of corn which is harvested (E)
24. The direction a slope faces (downhill) (A)
25. A term to describe chemicals (fertilisers or nutrients) being lost from soils (L)
26. The direction from Point A to Point B (N)
28. The amount produce from agricultural production (Y)
33. Sixty_____ % of Australian land is owned by farmers (O)
34. A crop that has fingers and not imported into Australia (B)
37. A farm which has only one type of crop being grown (M)
39. Long term atmospheric conditions which dictate where certain crops can be grown (C)
40. The shape of the land (relief) (T)

Down

2. Watering crops to help them grow (I)
3. An pile of used materials; Aboriginal people used these to show what not to eat (M)
4. With modern advancements we may have lost these; by controlling water and temperature crop grow in (S)
5. This country exports more food than it imports (U)
6. A process where land is prepared for crops (T)
7. _____ modifications of crops can reduce biodiversity, but increase crop resistance to disease (G)
8. These introduce more nutrients and help crops grow (F)
10. A type of insect which can taste sour if you eat it (A)
14. Advancements in _____ can help gain higher yields in crops (T)
17. A natural material which metal can be extracted from once mined e.g. Iron (O)
20. Farming just to feed your own family – not profit (S)
21. A piece of farming machinery; moves and pulls (T)
23. Climate _____ can affect the ability to grow crops (C)
27. Point A has an altitude of _____ m (T)
29. Removing native vegetation for farming can cause the soil to _____ (E)
30. A prolonged period of below average rainfall (D)
31. The expansion of these areas means less area available for farming (U)
32. There are concerns that people may over _____ species particularly with rapid fire rifles (H)
35. The aspect at Point C (S)
36. Areas once covered by these in deserts are being turned into farm land due to underground water (D)
37. Rainfall is measured in _____ (M)
38. The arm of the UN which is trying to eliminate hunger (F)

Sustainable biomes crossword – Answers



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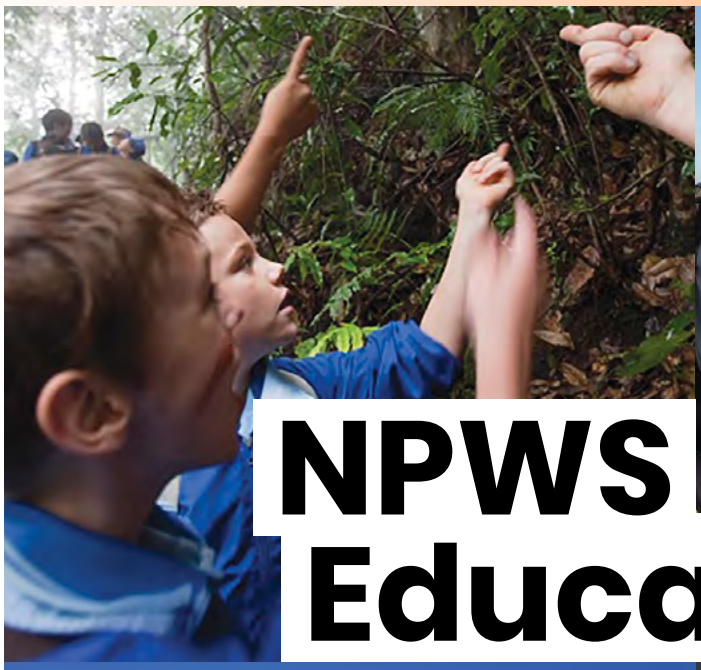
FIELDWORK OPPORTUNITIES



NSW GOVERNMENT

NATIONAL PARKS & WILDLIFE SERVICE NSW

NPWS Education

Bring your next outdoor learning experience into a national park

Excursions

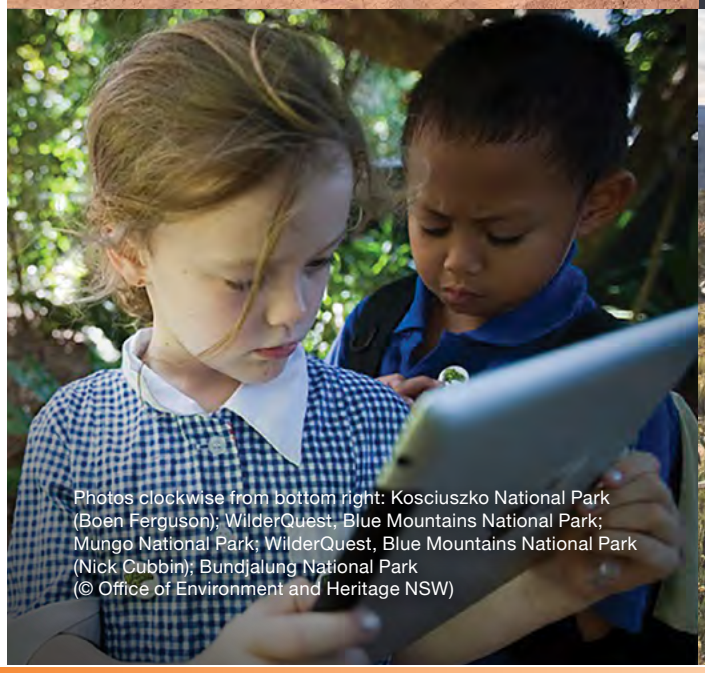
WilderQuest

Aboriginal Education

Online Resources

Teacher Professional Development

nswparks.info/education



Photos clockwise from bottom right: Kosciuszko National Park (Boen Ferguson); WilderQuest, Blue Mountains National Park; Mungo National Park; WilderQuest, Blue Mountains National Park (Nick Cubbin); Bundjalung National Park (© Office of Environment and Heritage NSW)

nationalparks.nsw.gov.au

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THE CONVERSATION
Academic rigour, journalistic flair

Originally published in The Conversation, 2016

https://theconversation.com/urban-sprawl-is-threatening-sydneys-foodbowl-55156

Urban sprawl is threatening Sydney's foodbowl

Sydney loves to talk about food, and the housing market. But rarely do we talk about the threat that housing poses to the resilience of Sydney's food system.

If we continue along the path we're on, Sydney stands to lose more than 90% of its current fresh vegetable production. Total food production could drop by 60% and the city's supply of food from within the basin could drop from 20% of total food demand to a mere 6%.

Like most Australian cities, Sydney is facing an influx of people – 1.6 million new residents are expected over the next 15 years.

Competing priorities for land are compounded by this growing population, as well as by planning laws that favour development over agriculture – not to mention a changing climate. Cities worldwide are facing the same issues as we try to feed a growing population with limited resources.

The future of Sydney's Food Bowl *https://youtu.be/QzlPG7nkp5s*

Protecting farmers

Sydney's fertile soils are being paved over at a rapid rate. Large portions of areas that currently grow Sydney's fresh produce are earmarked for release for housing development.

Currently, the planning system does not prioritise agriculture as a land use, meaning urban sprawl into potential farmland continues relatively unchecked. Instead, planning tends to focus on whichever use has the greatest economic value.

In an overheated housing market such as Sydney's, this tends to mean agricultural land is allowed to be rezoned for houses or other higher-value land uses.

As city land prices rise, more people are moving further out for a "tree change". Lower land prices on the city's fringe allow families to purchase large homes and lots at a lower price than in the city.

But many of these new rural residents don't like the early morning sound of tractors and the smell of manure on neighbouring farms, and make nuisance complaints to their local council. These complaints often result in tough operating restrictions being placed on farmers' activities, such as limits on hours of operation and types of fertiliser that can be used.

These restrictions are introduced by councils to appease local residents and are in accordance with noise pollution laws designed for urban residential areas. But they can have significant impacts on farm viability. In several instances, such restrictions have pushed marginal farms into the red, eventually forcing farmers off their land and out of the basin.

The New South Wales government is interested in taking steps to ameliorate this problem, as demonstrated through its recently tabled Right to Farm policy. This seeks to ensure that farmers' right to operate their business is protected against nuisance complaints.

Why growing food in Sydney is important

There are enormous benefits to growing fresh food in the Sydney basin – and, indeed, near any city. Perishable foods such as Asian greens and eggs can be grown close to market, reducing spoilage, waste and food miles, and buffering against spikes in fuel prices.

Agriculture and food processing are labour-intensive, providing significant local job opportunities. In fact, the benefit of Sydney's agriculture to the economy is estimated at upwards of A$4.5 billion. This includes jobs in storage, processing, transport and retail.

CHALLENGES TO FOOD PRODUCTION

A changing climate will mean many of Australia's important foodbowls, such as the Murray-Darling Basin, are likely to be more vulnerable to droughts and floods. Sydney's higher rainfall and fertile soils will become even more suitable for growing food, meaning their importance to Sydney's food supply will grow.

Farms on the fringes of our city will help buffer the city against the impacts of climate change, by cooling the city and helping wildlife move between habitat.

Food produced in close proximity to the city can also be fertilised by nutrients and organics in urban food waste, garden waste and wastewater. Accounting for these sources, Sydney actually has 15 times more phosphorus supply than agricultural demand. That means local food systems can better buffer against the growing global threat of phosphorus fertiliser scarcity, a threat that could lead to further fertiliser price spikes and supply disruptions.

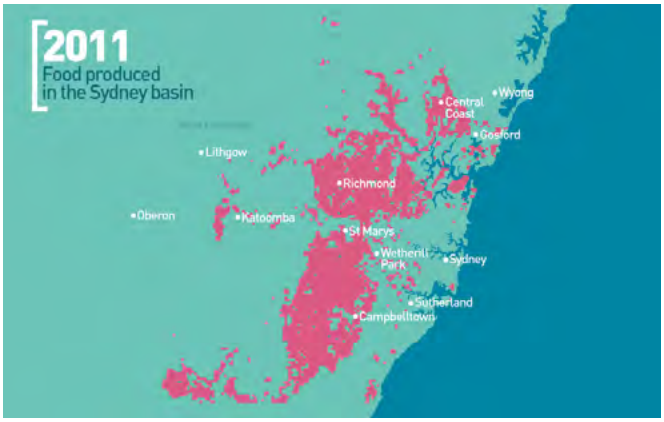
Sydney's farms also help buffer the city against disruptions to food supply. For example, if a bushfire or fuel shortage cut transport routes into Sydney, the city would have only two days' stock of fresh produce.

Our research shows that in the face of dramatically increasing population, Sydney stands to lose these benefits.

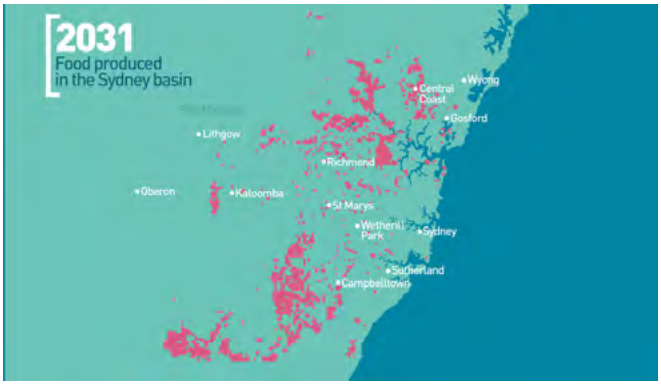
A similar study in Melbourne found their city's foodbowl could plummet from meeting 41% of Melburnians' food demand to 20%.

Unlike Melbourne, Sydney is geographically constrained by mountains on one side and ocean on the other, meaning there is nowhere for agricultural production in the basin to go. Our agricultural production is literally being chased to the hills – and this at a time when we face the challenge of feeding over a million extra mouths.

We've mapped Sydney's current and future food production. The pink areas of the images below are areas where food is produced. As the maps indicate, the areas producing food in 2031 will dramatically decrease if we continue along the path we're on.



Sydney's peri-urban farms produce 20% of the city's food supply. Source: Institute for Sustainable Futures UTS, Author provided



If we allowed unchecked urban sprawl, Sydney's farms might produce only 6% of the city's food supply. Source: Institute for Sustainable Futures UTS, Author provided

A better food future

Our city plans need to value and better protect agriculture from urban sprawl. Planners need to make decisions based on evidence to balance competing land uses.

These decisions need to take account of the full suite of values and benefits we gain from Sydney farmers, not just the economic gains we stand to achieve by converting the land to houses.

Farmers in the basin need better commercial conditions, a fair price for commodities, land security and support from other residents.

Sydneysiders need access to affordable housing, jobs and infrastructure.

But, equally, they need access to nutritious and affordable food, reversing the high rate of obesity and diabetes, and "food deserts" without access to groceries particularly prevalent in Western Sydney.

Through increased awareness and accessibility, food shoppers can also support local food producers, increasing the resilience of Sydney's food system and simultaneously reducing the environmental footprint of food.

However, strategic policies and plans are needed to ensure that agriculture is valued and prioritised as an important land use and economic activity within our city, to ensure that buying local food is a choice that consumers can make in future.

See more at Sydney's Food Futures – http://www.sydneyfoodfutures.net/

The Authors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BEES, BIOMES AND FOOD SECURITY

Lorraine Chaffer, President GTA NSW & ACT

A honeybee pollinates a flower (Creative Commons). Source: https://en.wikipedia.org/wiki/Honey_bee#/media/File:Pollination.jpg

World Bee Day

World Bee Day was an initiative launched in Slovenia on 2014 to increase global awareness about the need to protect bees due to the serious decline in bee populations worldwide. In December 2017, the UN, supported by all UN states, declared May 20th to be World Bee Day. As awareness increases opportunities to restore bee health and bee numbers also increases.

Bees, food and biomes

Much of the world's food production and food security depends on bees and insects which pollinate fruit, vegetable and pasture crops. While not all crops need honeybees for pollination, it is agreed that an increase in the size, quality and/or stability of crop harvests for approximately 70 per cent of the world's main crops requires honeybee pollination. In many biomes and ecosystems, plant species depend on pollinators for survival … the loss of these resulting in further losses in biodiversity and increased vulnerability.

Learn more about the essential role of bees in food production

Podcast: The power of pollinators Food and Agriculture Organization of the United Nations – http://www.fao.org/news/podcast/tzh-06-the-power-of-pollinators-why-more-bees-means-better-food/en

> *"In Australia, two-thirds of all horticultural and agricultural crops need honeybees for optimal pollination. Many fruits, such as apples, raspberries and peaches, are more productive, produce better, more attractive fruit and even store better and for longer when they are serviced by honeybees. Lucerne, which is an important crop for feeding livestock such as cattle, is also much more productive when sufficient numbers of honeybees are available to promote pollination. Almond blossoms rely completely on honeybees for pollination—so, no bees, no almonds. It has been estimated that the value of honeybee-reliant agriculture in Australia is AUD $4–6 billion per year and rising"*
>
> From: AustralianAcademy of Science: Getting the buzz on the value of bees – https://www.science.org.au/curious/everything-else/bees

Threats and challenges

Pollinator species are in decline along with global biodiversity. Since the 90's, the worldwide bee population has declined rapidly. There are many possible reasons for this decline including the usage of pesticides, habitat destruction and climate change. The challenge to future food production is maintaining honeybee numbers along with other pollinator species and halting the decline in global biodiversity.

Opportunities

Australian universities and research organisations such as the CSIRO have researchers working on understanding be behaviours, the threats to honeybee populations and ways to combat their decline. Thousands of honey bees have been fitted with tiny sensors as part of a world-first research program to monitor the insects' movements. Understanding bee behaviour while they travel through farm crops will help scientists trouble shoot immediate threats to their survival.

Bee with a backpack… of the sensor variety

Source: Photo CSIRO – www.csiro.au/en/Research/BF/Areas/Protecting-Australias-agricultural-industries/Robot-technology/Swarm-sensing

> *"CSIRO is also involved in bee research initiatives, leading the Global Initiative for Honeybee Health. This includes a project where 5000 bees have been fitted out with tiny sensors, then let loose into the environment. When the bees pass certain checkpoints, the sensors are detected, allowing the researchers to create a map of the bees' movements and better understand how they move through the landscape"*
>
> Australian Academy of Science – https://www.science.org.au/curious/everything-else/bees

Unit of Work: Love Food: Love Bees

Act for Bees / Cool Australia

See: Love Food? Love Bees – Powerful pollinators – Geography Years 9 & 10 – https://actforbees.org/resources/curriculum/

Delve into Food Security with the NEW Love Food? Love Bees!–Food Security and Sustainability– Year 9 & 10

Most students connect bees to a painful sting or the honey on their breakfast but have little idea about their crucial role in Australia's food security. Most fruit, nuts, vegetables, seeds and even livestock feed are dependent on bees.

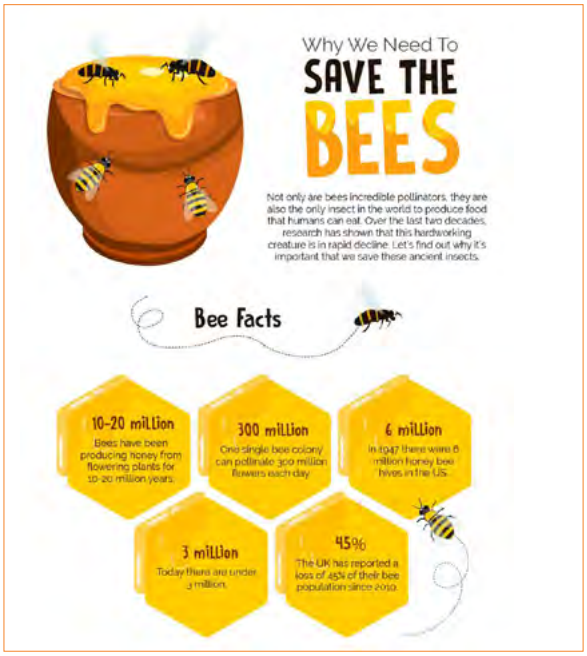
We've teamed up with Cool Australia to create a new package of Love Food? Love Bees!-Food Security and Sustainability- Year 9 & 10 looking at the powerful role of pollinators in food production, the barrage of threats leading to their demise and, importantly, the steps we can take to create change.

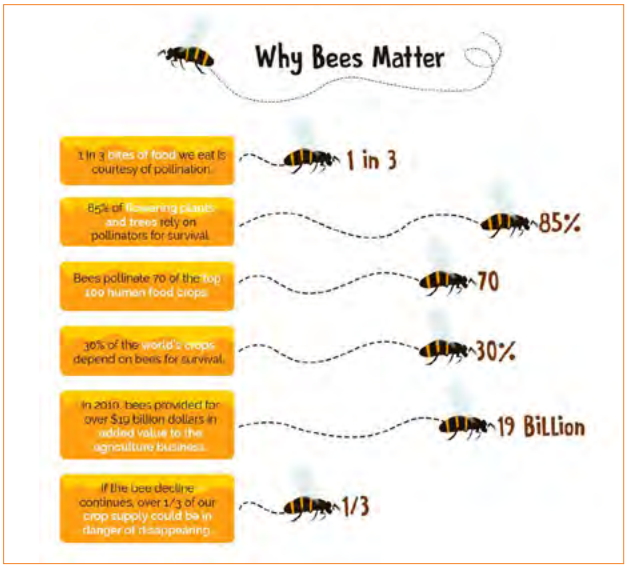
In the lesson Introduction to Food Security, students learn about the role of bees in food production and create a supermarket cheat sheet that their families can use to make more informed food choices.

"Dead bees cover the ground on King Island!" Immerse your students in a hypothetical scenario as part of the lesson Powerful Pollinators. Your students will create a flow diagram to illustrate how the decline in bees will impact the island's food security.

Examine the school canteen menu as part of the lesson Taking Action for Food Security. For this inquiry task, students assess the sustainability of ingredients and then create a proposal outlining more sustainable food options.

Teaching resource on Bees and Food Security (Screen Capture) https://actforbees.org/resources/curriculum/





Infographic Source: Created by Any Pest – http://anypest.ca/
Creative Commons Sourced – https://www.visualistan.com/2016/09/why-we-need-to-save-bees-infographic.html#postimages-1

Farming on thin ice

The Crawford Fund News
Bianca Das and Anika Molesworth

Article reproduced with permission – The Crawford Fund for a food secure world
https://www.crawfordfund.org/news/news-farming-on-thin-ice-march-2019/

Bianca Das (left) and Anika Molesworth (right) will be setting off to Antarctica later this year.

Later this year, two young agricultural researchers who are both former Crawford Fund scholars and now RAID Network members, will be setting off to Antarctica. They were selected to take part in an incredible 12-month program with a cohort of 95 women in STEMM (science, technology, engineering, mathematics and medicine) from around the globe. The Homeward Bound programme is a global leadership initiative to equip women in STEMM with strategic and communication capabilities in order to influence policy and decision-making regarding the sustainability of our planet.

Bianca Das is a soil scientist and agricultural systems modeller, and just started her PhD investigating computer modelling as a tool to enhance soil phosphorus efficiency in farming systems with The University of Queensland and the CSIRO. She was a Crawford Scholar in 2013, and is currently an Events Coordinator for the RAID Network central committee.

Anika Molesworth is undertaking her PhD with the Centre for Regional and Rural Futures at Deakin University. Her field trials have been conducted in the Riverina of NSW and lowlands of Laos and Cambodia, though Anika bases herself on her family's sheep farm in far west NSW near Broken Hill. Anika was a Crawford young scholar in 2015, is now a NSW Crawford Fund committee member, and is a NSW state representative for the RAID Network.

Here they answer a few questions about their motivations and interest in international agriculture. You can help them both in their quest to Antarctica by supporting their crowdfunding effort mentioned at the end of the article.

How did you discover your love for ag and interest in international ag development?

Bianca:

Growing up in New Zealand, I developed a strong connection to the land and a passion for protecting the environment. But it wasn't until my undergraduate studies at Lincoln University that I discovered a passion for agriculture. New Zealand has struggled with nutrient management in waterways for decades and my classes were often wrought with debate over the difficulty of managing this problem at a practical level. With the help of some very inspiring soil science researchers, I learnt that efficient soil management can create 'win-win' strategies to help farmers reduce nutrient loss. This drove my passion for scientific research in agriculture.

As a first generation Kiwi, with Irish, English and Bengali heritage, I have always been fascinated with other cultures and international relations. I did a summer internship in rural Punjab, in northern India after my 2nd year at university. I helped in after school care, waste management and developing organic farming. Here I was confronted with the stark reality of helplessly trying to help. With little support, few resources, no funding and only knowing few works in Punjabi I realised – I had little impact. I learnt that working in international development is about enabling locals to achieve their goals, not doing it for them. Upon returning to my studies, I decided that I needed to build my skill set in soil science and agriculture to offer to those who need it. Since then I have, with RAID and the CSIRO, been able to help rural communities all over the world.

Anika:

My family purchased our outback sheep station in Far West NSW in the year 2000. I was 12 years old and it was the start of the decade-long Millennium Drought. We had fallen in love with this starkly beautiful piece of Australia and began curating our future on the farm – but then the rain stopped falling. It barely fell for the next 10 years. It was a steep learning curve into farming, and it opened my eyes to the fragility of our natural world, and how connected everything and everyone is to it.

Climate change means this part of Australia – my home – will become hotter and drier, and will experience more frequent and intense droughts and dust-storms. It was living through the Millennium Drought, having my eyes opened to its impacts and understanding that worse it yet to come that has cemented my commitment to farmers and my work to ensure their resilience in the face of climate change. This interest to understand climate change as it impacts agriculture and lessen its effects has taken me around the world, and has made me realise farmers in many other countries, particularly developing

Anika Molesworth

nations, stand much closer to the precipitous than we do in Australia. It's also helped me realise that transferring knowledge between countries, sharing ideas and working together on finding solutions is what is needed to overcome global challenges.

What do you see are the big challenges facing the sustainability of our planet?

Anika:

I see the big issues being feeding a rapidly growing global population with reduced environmental footprint on a backdrop of climate change. And these big issues have big challenges in engaging people to solve them. The most important topics of social and environmental sustainability can seem daunting and can trigger disengagement, and I think one of the biggest threats to our planet is the belief that someone else will save it. What each of us does makes a difference – from a mum grocery shopping to the highest of policy makers – we share responsibility for our common home. Owning that responsibility and agency is difficult, but we're in it together, and together we can successfully implement the solutions to these big challenges.

Bianca:

We are beginning to realise sustainability is not just an issue for conservationists anymore – it's a problem that affects all of us in our everyday life – our health, our income, our economy and our quality of life. We need more bold leaders to take action and strategic steps in policy-making. More specifically, I think nutrient management, water management, improving biodiversity and waste reduction are key factors we need to focus on to achieve sustainable agriculture and a sustainable planet. I believe there is currently a lack of quality leadership in sustainability at the higher level which is slowing progress on action. To improve leadership quality we need more diverse and credible leaders.

What are you doing about tackling these challenges?

Bianca:

I believe in creating a healthy planet that nourishes all those who inhabit it. But I believe this isn't just up to our farmers – they need technical support and advocates to communicate their achievements to the wider public. I work on creating 'win-win' situations to support farmers to increase productivity by using their resources more efficiently and reduce losses to the environment. My PhD research is currently exploring computer modelling as a tool to help farmers find strategies to improve their phosphorus fertiliser efficiency. Other examples of my research include quantifying greenhouse gas emissions from dairy soils, restoring and revegetating saline-sodic soils, reducing nitrogen losses from sugarcane systems into reef catchments, understanding wheat yield gaps in Australia, and incorporating native vegetation onto farms to provide stock fodder and increase biodiversity. I also volunteer for OzHarvest and the RAID Network to promote sustainable use of food in Australia and around the world.

Anika:

The big challenges require all hands-on deck – people contributing ideas and skills from all sectors, all experience levels. My interest in better understanding the impacts of climate change on ag, and then communicating these topics to others has led me to undertaking a PhD in agricultural and environmental science, meeting royalty and global leaders, and talking on stages like TEDx in front of thousands of people. I am working to lift the voices of farming youth with the Young Farming Champions and the Youth Voices Leadership Team, and to advocate for strong climate and energy policies with Farmers for Climate Action so ambitious climate change strategies are put in place.

What is the role of women in agriculture?

Anika:

Women are powerful change agents. They play key roles in the health and wellbeing of their families, their children are often at the forefront of their minds, and so they are key in designing the settings that support them and the next generation.

I think women working agricultural and environmental research are particular gems because they are facing up to the big challenges. These challenges are difficult, but that's not because we don't have the ability to address them, they are difficult because we are setting out to answer questions that have never been answered before. To find new solutions and contribute new knowledge to our world. Bold, creative, critical-thinking women working agricultural and environmental research are expanding our knowledge, shaping the future and that's exciting.

Bianca Das

Bianca:

I think that women play an absolutely pivotal role in the future of agriculture. In Australia and in most developed countries – women are not 'seen' as farmers, though they are often seen as the backbone of any farming community. The stereotype that there is no role for women on the farm is being challenged. Today, women produce 49% of real farm income in Australia and indigenous women have more than 50, 000 years of knowledge in living off the land. But women are grossly underrepresented on regional bodies such as in agricultural companies (7%) and councils (9%). The Invisible Farmer Project is an ongoing study that highlights these facts and the stories of the incredible women (like Anika) who are out working on the farm every day – and doing a fantastic job at it.

In developing nations, women make up nearly 50% of the labour force in agriculture, but benefit very little from their involvement. Recent statistics show that if women had the same opportunities as men, yields would be 20–30% higher. This means things like better education and access to medical support, decision-making power and ability to access credit to start a business.

While rural women are the key drivers of agricultural sustainability, I think that men are key factor in enabling their daughters and sisters to flourish. As the old saying goes, when you have a strong mother, you have a strong family, and strong families build strong communities.

Will you help Bianca and Anika on their exciting adventure?

Bianca and Anika are currently crowdfunding in order to raise the funds required to participate in the Homeward Bound programme.

If you would like to contribute to their fundraising efforts, please follow the links below.

Bianca' crowdfunding page
Anika's crowdfunding page

A new study finds that climate extremes, like heatwaves and droughts, are impacting the food we get from crops. By understanding these effects we can better plan for climate change

Australia has just experienced its hottest summer on record as well as a succession of climate extremes. Currently, a vast area of New South Wales is drought-affected. Floods have devastated vast sections of Queensland while bushfires and cyclones wreaked havoc across the country.

And bearing the brunt of these extremes are many of Australia's farmers. In fact, last year's national farm production was down on 2016 results.

Extreme weather can cause harvest loses, risking farmer's livelihoods as well as food security. Picture: Getty Images

Droughts, heatwaves, cold extremes or floods can all cause severe harvest losses and pose great risks to the livelihoods of farmers, as well as the food security of communities around the world who rely on agriculture.

If we go back to the Millennium Drought in Australia which began in 1997 and ran through until 2009, agricultural production fell from 2.9 per cent to 2.4 per cent of Gross Domestic Product, with drought playing a significant role.

Between 2002 & 2009, rice production in South-East Australia dropped by 99 per cent, while wheat yields declined by 12 per cent compared to pre-drought levels.

Due to climate change, the frequency and severity of climate extremes is predicted to further increase in most regions worldwide. It means that our global crop yield – the measurement of the amount of agricultural production harvested per unit of land area – will be affected.

It also means that there's work to be done to plan for, and improve the resilience of our food production systems. But in order to do this, it's important to understand several things: how climate extremes interact with agricultural yields, to what extent crop yields are influenced by climate extremes and how these interactions differ between agricultural regions.

CRUNCHING THE CLIMATE NUMBERS

Our new study, published in Environmental Research Letters, investigated the effects of climate conditions on yield during the growing season, using climate and climate extremes datasets with near-global coverage and a high-resolution agricultural database.

Between 2002 and 2009, rice production in South-East Australia dropped by 99 per cent. Picture: Getty Images

This database contains regional crop yield data for the four major crops – maize, rice, soybeans and wheat.

By applying a machine learning algorithm, called **Random Forest**, we can then investigate the relationship between the year-to-year climate variations and the crop yield fluctuations.

Random Forests is a statistical tool that uses a large number of decision trees (hence the name) that are used to identify patterns in the data and create statistical models. The benefit of Random Forests is that they can capture very complex, non-linear relationships between variables.

Using Random Forests, we looked at the effect of the growing season's mean climate (that is, temperature and precipitation) and a number of climate extremes indicators (like hot and cold temperature extremes, drought and heavy precipitation events) on yield anomalies.

Overall, changing climate conditions during the growing season explain 20 to 49 per cent of the variance of yield anomalies of all crops we investigated, at the global scale.

This indicates that year-to-year changes in temperature and precipitation, including the growing season mean and extreme events, account for a considerable fraction of year-to-year yield fluctuations.

And these explained variances are especially high for maize: with values between 45 and 55 per cent for all continents, except South America and Oceania.

There are hotspot regions that are critical for global production. Picture: Getty Images

But how large is the impact of climate extremes?

THE EFFECT OF CLIMATE EXTREMES ON CROP YIELDS

We compared our results with the outputs of a second statistical model, which only uses the mean growing season temperature and precipitation as predictors for any yield variations. This means we can quantify how much the explained variance drops when climate extremes are excluded from the model.

As a result, we found that climate extremes indicators explain about 18 to 43 per cent of the variance of year-to-year all crop yield anomalies. For maize, soybeans and rice, this represents more than half of the explained variance, emphasising that climate extremes play a very significant role in understanding and predicting yield variations in these crops.

Interestingly, temperature-related variables – both the mean growing season temperature and temperature extremes – play a more significant role in predicting yield fluctuations than precipitation-related variables, such as total growing season precipitation, drought or heavy rain.

It also indicates that a meteorological drought (i.e. below-average rainfall) alone can't accurately predict yields, but that soil moisture drought – which is affected not only by rainfall, but also other factors, like temperature, solar radiation, water vapour pressure deficit, and the properties of soil and vegetation – could be potentially better predictors of yield anomalies.

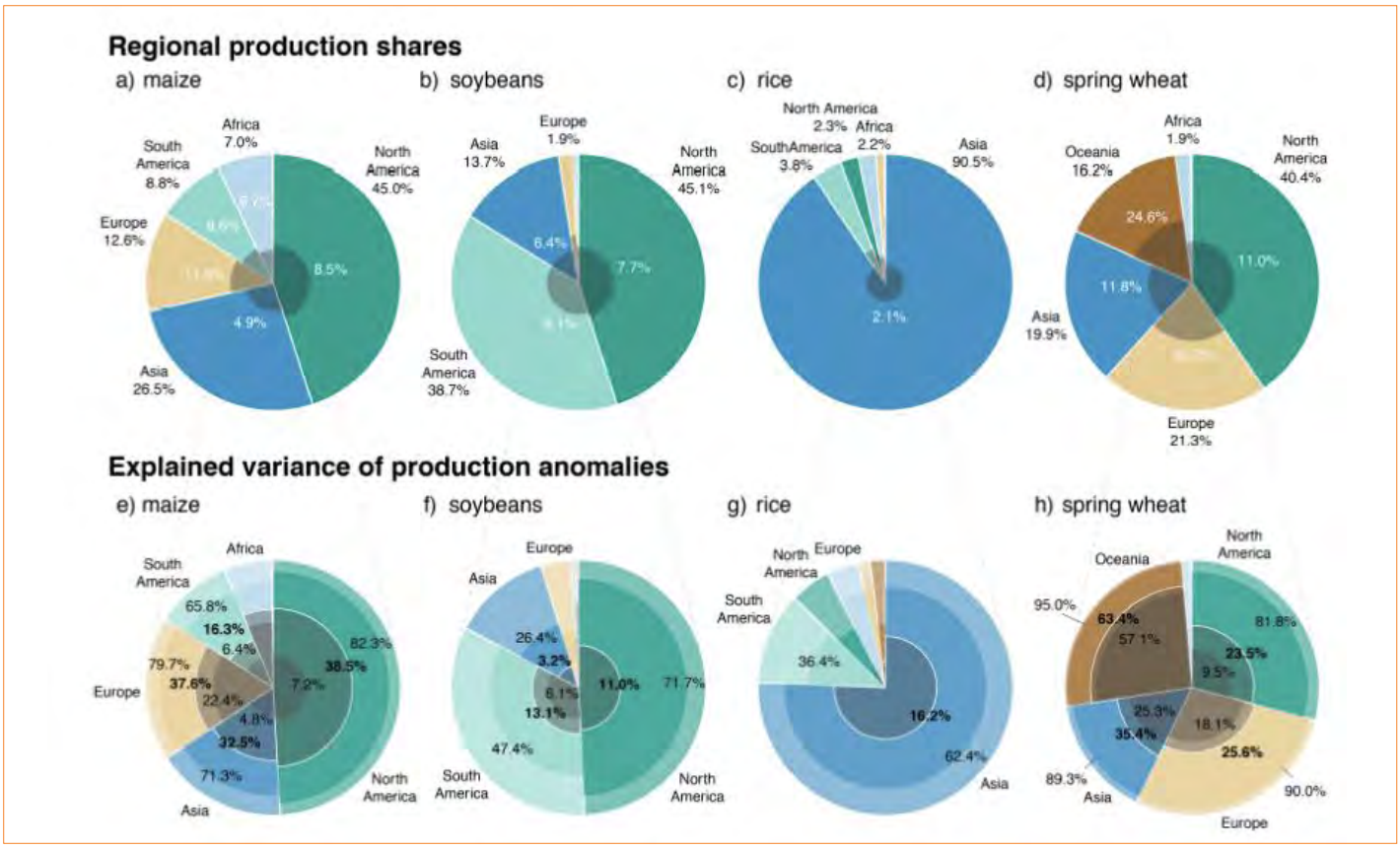
IDENTIFYING THE HOTSPOTS

So, what does this all mean for global agricultural production?

We have identified hotspot regions that are critical for global production, as they are contributing a large fraction of the world's food, but are also particularly susceptible to the effects of climate extremes.

These regions are: North America for maize, spring wheat and soy production, Asia for maize and rice production, and Europe for spring wheat production.

While these hot spot regions are mostly in industrialised, high-input crop producing areas, climate extremes are also critical in other regions, where the contribution to global production might be small, but the reliance of communities on subsistence farming is high.



Top row (a-d) shows mean production shares for each continent, with the inner circle showing the standard deviation of production anomalies. The bottom row (e-h) shows the share of production anomalies for each continent. The three inner circles represent (from outside to inside); i) the faction of variance of production anomalies that can be explained by yield anomalies; ii) the fraction of variance of production anomalies explained by mean climate conditions plus extreme indicators; iii) the fraction of variance of production anomalies explained by mean climate conditions. Picture: Supplied

Overall, our study highlights the importance of considering climate extremes for understanding and predicting the yield we can expect from our crops.

It may be used to support the development and improvement of global and regional seasonal forecasting systems for agriculture – identifying key climate factors and estimating their contribution to yield fluctuations, for each region and crop individually.

LINKS TO RELATED MEDIA REPORTS

1. Can we have urbanisation and enough to eat
https://pursuit.unimelb.edu.au/articles/we-can-have-urbanisation-and-enough-to-eat

2. The grand challenge of feeding 9 billion people
https://pursuit.unimelb.edu.au/podcasts/the-grand-challenge-of-feeding-9-billion-people

3. Farming the future
https://pursuit.unimelb.edu.au/articles/editing-farming-the-future

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Associate Professor Lisa V Alexander
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Dr Deepak K Ray
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Dehydration & rehydration of the Australian landscape

Campbell Wilson, The Mulloon Institute

If you were to step back in time and join the early European explorers as they journeyed across the Southern Tablelands of NSW, it is highly likely that if you wandered onto one of the broad valley floors that are typical of the region, you would find a scene similar to that shown in Figure 1.

Figure 1: An intact swampy meadow containing a chain-of-ponds. This landscape setting was common at the time of European settlement.

These systems are commonly referred to as swampy meadows, and are typified by broad floodplains dominated by dense tussocks, sedges and rushes.

These settings have undergone significant changes in recent times, at both geological and human time scales. One of the major reasons for these changes through time is that plants are the architects and builders of these floodplain systems. As will be seen in the following sections, any major vegetation disturbance can have significant consequences for the underlying landform.

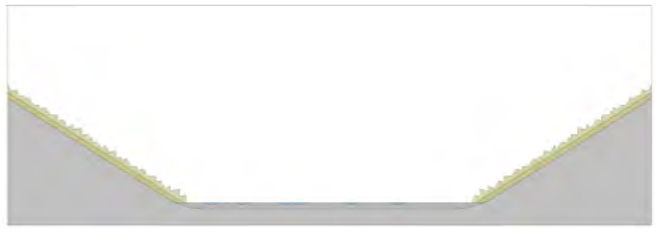
ICE AGE TROUBLES

At a geological timescale, floodplains similar to those in Figure 1 are actually quite transient features, with studies indicating that whole floodplains they have built up and washed away on multiple occasions over hundreds of millennia.

One of those occasions was during the last ice age. During this period, which finished about 12,000 years ago, Australia experienced very little glaciation other than a few spots high in the alps of NSW and Tasmania. Although this meant that valley floors weren't scraped back to bedrock by huge slabs of ice like they were in large portions of North America, Europe and Asia, the climatic influence on vegetation resulted in a fairly similar outcome for upland valley settings.

During this period, the climate of southeastern Australia was obviously colder, but it was also more arid. This climatic combination significantly reduced overall biomass and groundcover, which meant both rapid runoff from the hills and few plants present to bind and stabilise the valley floors when flash storms arrived. As a result, the extensive floodplains that had built prior to the ice age were almost completely washed away. All that remained on many of the valley floors were wide beds of alluvial gravels, with streams likely to have been braided, containing multiple criss-crossing flow pathways (Figure 2).

Figure 2: Cold and arid conditions in southeastern Australia during the last ice age significantly reduced vegetation across the landscape. Flash runoff and compromised riparian vegetation resulted, with floodplain systems of the tablelands often completely eroded back to wide beds of alluvial gravels containing braided streams.

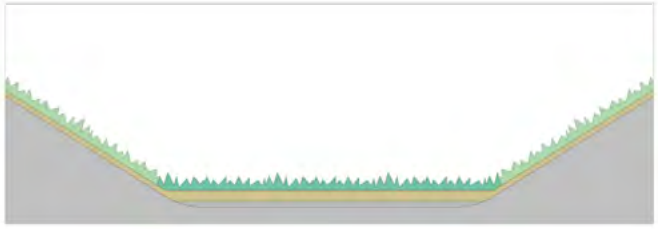


Maules Creek, NSW

PLANTS RULE THE HOLOCENE

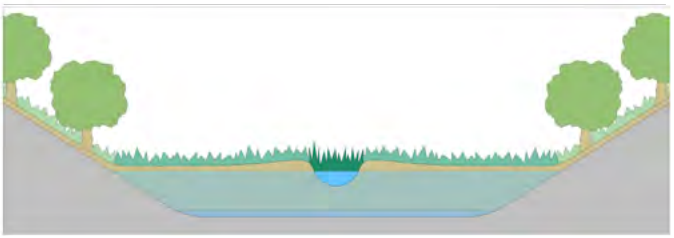
As the earth entered the Holocene just under 12,000 years ago, the warmer and moister climate of southeastern Australia became far more favourable for plant growth. The well-hydrated beds of gravels began to colonise with moisture loving plants. Anything that water rubs up against slows it down, and the roughness provided by the establishing plant systems resulted in the accumulation of fine sediments, and began raising valley floors (Figure 3).

Figure 3: Exiting the last ice age, conditions became far more favourable for plant growth with the increased warmth and moisture available. Vegetation systems colonised the gravel beds and began to trap fine sediment, raising valley floors.



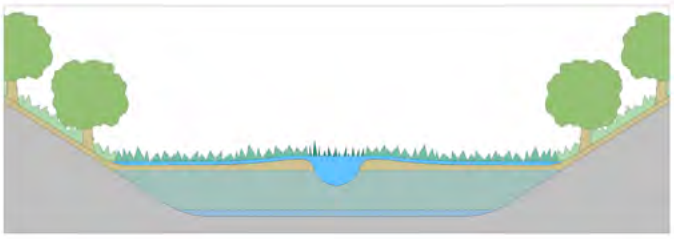
An ongoing favourable climate, in combination with consistent land management practices by Indigenous Australians, saw vegetation continue to flourish on the valley floor. The dense tussock and sedge that typify swampy meadows (Figure 1) helped to slow flow and capture even fine sediment, continuing to vertically build fertile soils over time. The considerable flow-resistance within an intact swampy meadow helps to store moisture within the floodplain aquifer, and as a result the watertable is often close to the surface. If a chain-of-ponds is present, this provides a window of insight into the proximity of the watertable to the surface (Figure 4).

Figure 4: Dense vegetation helps to vertically build sediment and store moisture within the floodplain aquifer, with watertables commonly close to the surface.



If channels are present, they tend to be shallow and discontinuous. The dense vegetation flanking these channels, and surrounding ponds if they are present, ensures that if a major runoff event does occur, there is considerable resistance present. This slows the flow, causing it to rise and spill its banks, spreading into a passive sheet across the floor of the floodplain (Figure 5).

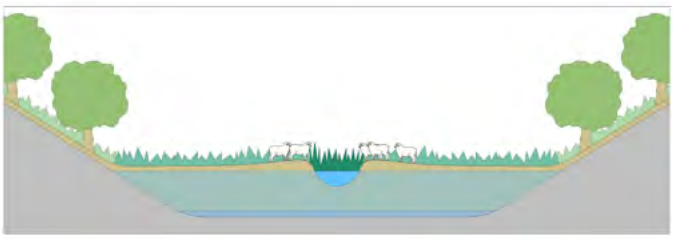
Figure 5: Dense riparian vegetation helps to slow flow, causing it to spread into a passive sheet across the floor of the floodplain.



EUROPEAN IMPACTS ON A FRAGILE LANDSCAPE

The extensive native grasslands that existed at the time of European settlement were a product of the skilled and deliberate use of fire by Indigenous land managers. These grasslands were particularly attractive for sheep production, and chains-of-ponds fed by the alluvial aquifers offered a consistent water supply (Figure 6).

Figure 6: The extensive native grasslands that existed at the time of settlement as a result of skilled indigenous land management were ideal for the development of pastoralism.



The imposition of a range of European land management practices on the older and more fragile Australian landscape had significant hydrological impacts. In particular, the clearance of woody perennials and overgrazing of native pastures due to the proliferation of both domestic livestock and feral animals, resulted in a considerable increase in surface runoff. Vegetation on valley floors was also severely affected by grazing, the impact of hard hooves that were previously absent, and deliberate drainage for cropping and parasite reduction purposes (Figure 7).

The combination of increased runoff and streamflow, reduced flow resistance and less stabilising-vegetation resulted in severe and widespread gully erosion like no other time in the last 10,000 years (Figure 8). When a gully forms, it drains the adjacent floodplain aquifer, dropping the watertable down to depth of the new gully floor (Figure 9). Once this occurs, not only is the vegetation on the floodplain surface now at the mercy of

our erratic rainfall patterns, even the largest streamflows are commonly fully contained within the channel, without any surface interaction (Figure 10).

Figure 7: The imposition of a range of European land management practices severely impacted vegetation within a few decades of settlement. The concentration of hard hooved livestock around waterholes particularly impacted vegetative cover in these settings.

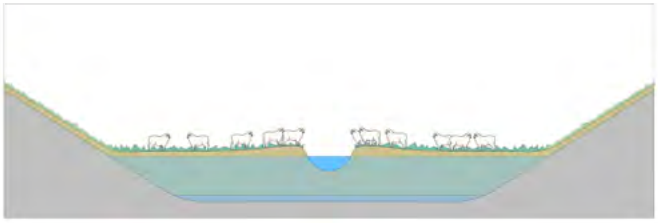


Figure 8: The combination of increased runoff (due to reduced perennial vegetation and severely grazed groundcover) and reduced flow resistance and soil binding root systems on the valley floors, resulted in the widespread incision of swampy meadows.

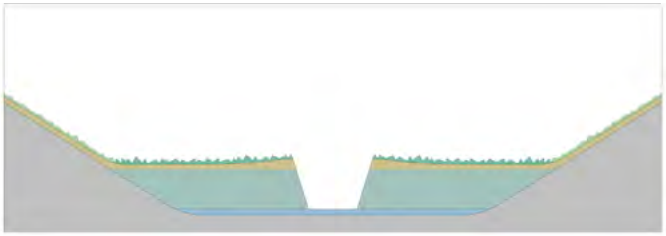
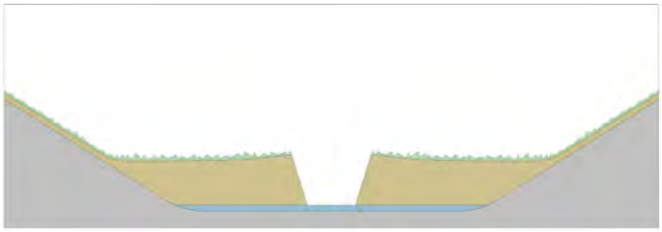
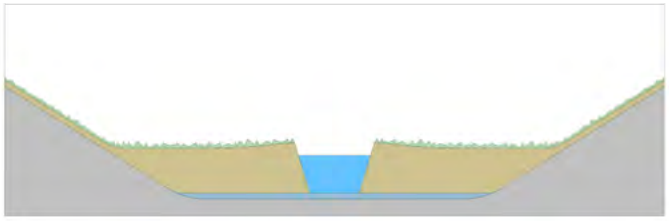


Figure 9: Newly formed gullies acted as drains for the floodplain aquifers, dropping the watertable to the depth of the channel floor.



River bank erosion

Figure 10: Within an incised system, even large flows are commonly contained within the channel, resulting in very little interaction of moisture or fertility with the surrounding landscape.



JUST ADD WATER

In recent times, there has been a growing understanding of the range of functions and resilience that intact swampy meadows can bring to our harsh climate and old landscapes. Landholders have been particularly interested in the way they act as a sponge and help to buffer drought conditions both locally and at a catchment scale. This has led to landholders installing series of structures within incised channels to reinstate some of the old geomorphic, hydrological and ecological patterns and processes.

An example of this sort of work can be seen in the before and after images in Figure 11 & Figure 12 respectively. These photos are taken at Peter's Pond, one of the structures at the base of a 3 km long riparian restoration project on Mulloon Creek Natural Farms, near Bungedore, NSW. This project was initiated by The Mulloon Institute, with the work overseen by Peter Andrews, the founder of 'Natural Sequence Farming'.

Figure 11: A view towards Peter's Pond in 2006 before work commenced shows eroding banks and minimal vegetation on the site.

Figure 12: The construction of Peter's weir under the trees in the distance formed a considerable backwater, resulting in a marked increase in both aquatic and terrestrial biomass. This photo is the same orientation as Figure 11.

The pools that are associated with the series of structures, often weirs constructed from rocks, logs and stabilising vegetation, increase the hydraulic gradient and result in recharge of the adjacent floodplain aquifer (Figure 13), raising the watertable over time (Figure 14). The increased moisture available to plants on the floodplain surface, as a result of the watertable being to the surface, can result in a considerable increase in primary production on the floodplain surface. The increased vegetation within the channel and on the banks (Figure 12) also enhances the roughness and flow resistance along the system, and provides more opportunity to trap sediment and organic material.

This biomass can be periodically harvested and utilised elsewhere on the property to boost fertility and production.

Figure 13: Weirs installed within the incised channel form pools on the upstream side, resulting in recharge of the adjacent alluvial aquifer.

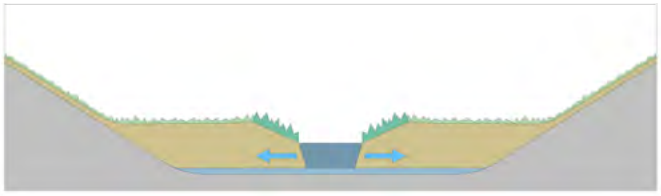
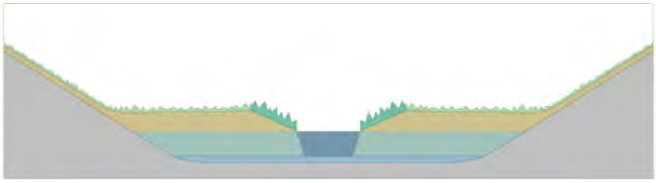


Figure 14: Over time, the watertable within the alluvial aquifer will tend to correlate closely with the level of structures, while increased biomass helps to slow flow and improve water quality and aquatic biodiversity.



The academic article "Sustainable water and energy management in Australia's farming landscapes' relates to this summary.

the mulloon institute
for environment, farming and society

The Mulloon Institute is a not-for-profit research, education and advocacy organisation that demonstrates, monitors and shares innovative approaches to regenerative land management.

The vision of the Mulloon Institute is to support the rebuilding of a resilient Australian landscape which produces the water, soil and biodiversity required to produce food and water security for the Australian population in the short and long term by working with landowners.

Land and water management strategies are aimed at rebuilding landscape function and resilience by rehydrating a landscape that has been dehydrated by 200 years of soil erosion and loss of organic matter by:

- rebuilding soil fertility
- fixing more carbon in the landscape
- restoring lost biodiversity
- improving water quality and availability
- moderating climatic extremes.

This result will be increased agricultural productivity, production of high quality nutrient dense food and improved human health and community cohesion.

To learn more:

- Visit the Mulloon Institute website – https://themullooninstitute.org
- Listen to Luke Peel speak about *Landscape dehydration and rehydration* on this link to his presentation at the GTA NSW & ACT Annual Conference 2019 – https://vimeo.com/334802339/b0c2e9baac

Sustainable water and energy management in Australia's farming landscapes

W J Hurditch
The Fifth Estate, Australia

Abstract

Australia's ancient geology, continental isolation and long, stable biophysical evolution have produced a unique and biodiverse flora and fauna complex, and well-balanced mechanisms for handling water, nutrients and organic production in its landscapes. When humans arrived more than 40,000 years ago, Australia's water, nutrient and energy systems were essentially self-sustaining. Western agricultural methods have since uncoupled parts of the innate productivity system that had long sustained these natural landscape functions. Many Australian farming and grazing businesses are today challenged from unreliable rainfall, declining soil health and rising debt. New landscape management approaches are now emerging. Some involve rehydration to reinstate Australia's natural biophysical landscape functions and processes, and can deliver both ecosystem resilience and profitability to farming enterprises. Benefits of landscape rehydration for farmers include greater water reliability, improved soil organic content and reduced reliance on high-cost artificial inputs. It also assists in mitigating climate change, as vegetated, rehydrated landscapes dissipate incoming solar thermal energy via the plant-driven photosynthetic process and the daily water cycle. This feature, until now little recognised in mainstream climate change discussions, adds a major dimension to this opportunity for the world's landscapes.

Keywords: Australia, salinity, rehydration, fertility, sustainable farming, soil.

1 Introduction

Globally the deterioration of landscape productivity is a rising concern. This is particularly so with the heightened food security challenge in the context of a world population that the United Nations predicts will exceed nine billion by 2030 [1]. Following the remarkable agricultural productivity gains of the first *Green Revolution*, into the 1970s, staple food production is today again being outstripped by population growth in critical places around the world. Examples are India and Nigeria, whose populations will likely overtake those of China and the United States, respectively, before 2030.

At the same time, the planet's available arable land base is shrinking, both in real terms and on a *per capita* basis [2]. As well as land losses to urban sprawl and infrastructure, physical land degradation today affects around 38 per cent of the world's agricultural soils [3]. Desertification, an extreme form of land degradation, increasingly impairs agriculture and prospects for dependent livelihoods around the world. It is estimated that within 15 years, up to 2.4 billion people may experience periods of intense water scarcity, displacing more than a quarter of them [4]. Clearly, loss of access to reliable water impacts farming yields. Where water is an increasingly limiting factor of production, food supply from formerly reliable sources cannot be expected to be sustained.

Nations considered to be developed are not immune from the insidious effects of land degradation. Australia, the subject of this paper, is a case in point. Today, Australia's food and fibre industries operate at varying levels of intensity across some 475 million hectares of grazing, cropping and intensive agricultural land. However in significant parts of these landscapes rates of water-driven soil erosion currently exceed soil formation rates by factors of hundreds and, in some cases, thousands. Acidification now affects around half of Australia's agriculturally productive soils, and is increasing in severity [5].

Land degradation and its consequent impacts on landscape productivity around the world are not new problems to science, agricultural practice, technology and policy. Recent decades have seen myriad national and global institutions and programs established to address it. Some have advocated ecosystem-based approaches to tackling land degradation, with many recognising the impact of climate change as another layer of complexity that adds to the urgency of the situation [4].

Ecosystem-based approaches acknowledge that answers to our sustainable landscape productivity conundrum may be found in the fundamental ecological and biophysical landscape functions that have operated, in concert, within nature for millions of years. These functions include nutrient and energy cycling, periodic flood events, evapotranspirational water cycles, chemical fluxes within biodiverse plant and animal assemblages, and organic matter accretion. But despite the increasing global attention to the value of an ecologically-integrated landscape approach, there are only a small number of peer-reviewed reports of how such an approach can be applied commercially and at scale [6].

Evidence assembled from studies of a range of farming approaches in Australia, Oceania, and parts of Asia and Europe [7–10], reinforces the utility and elegance of adopting an ecological approach to address the land degradation problem. Understanding and applying such management principles and approaches more widely can help address our increasingly urgent and global food and fibre production challenge, while helping moderate climate warming.

2 Australia's ancient landscape ecology and impacts of European settlement

Australia's biophysical landscape processes have evolved continuously in relative geological stability over millions of years. Gentle stream gradients and the scarcity of large waterfalls are examples of biophysical stability in much of Australia's land mass. Persistent plate-driven displacement of northern Australia's land surface could also be a contributor to some of Australia's benign landscape features [11].

Across wide areas of Australia, including around the now arid Lake Eyre Basin, rainforests and other moist ecological assemblages thrived in past climatic times [12]. Inland-flowing rivers brought fresh water, sediment and nutrients from the margins of the continent to the centre. As late as 45,000 BP freshwater mega-lakes in the Lake Eyre Basin persisted, until a long climatic drying phase reduced their area [13]. Even today, one can witness this "inland wetland" phenomenon in places like the still extensive Macquarie Marshes [14] and the inland floodplain of the Lachlan River [15]. Australia's coastal-flowing rivers tended to originate in short, confined valley systems and end in extensive dune-bound lakes and wetlands, with only occasional outflows to the ocean. Remnant examples today include the NSW Great Lakes system and the lakes of the Murray River mouth in South Australia [16].

Macquarie Marshes, NSW. Source: https://upload.wikimedia.org/wikipedia/commons/f/f9/Macquarie_Marshes_healthy_July_2008.jpg

It can be thus be argued that Australia's ancient landscapes were essentially self-irrigating, balanced ecological systems that maintained their functions in the face of climate extremes by tightly cycling nutrients, water and organic-bound energy. High primary productivity rates in parts of pre-European Australia were possible because of elegant nutrient and water conservation mechanisms that had evolved with the landscape's physical form and its unique biota.

Important conservative features of this landscape were based on step-diffusion processes [7], and included natural dissipative and buffering flow line structures variously termed "chain-of-ponds", "pool-riffle sequences", "in-stream wetlands" [17] and "swampy meadows" [18]. On a regional scale extensive anastomosing channel systems operated to capture and disperse water and sediment across broad inland floodplains [19]. These mechanisms served to buffer stream and overland flow energy, trap and aggrade the residues of successive landscape erosion and flood events, and build organic matter within the zones of peak biological production. Remnants of these phenomena can still be observed today, albeit in diminished scale and frequency.

Long before Europeans arrived, Indigenous Australians had brought about profound changes to the Australian landscape through, for example, their hunting of megafauna and a widespread use of fire [20, 21], perhaps even tipping the continent towards desertification [22]. However, common with other ancient cultures in the Asia-Pacific region, in some case dating before 5,000 BP, some groups of Australian Aborigines appeared to show a deep functional understanding of water and fertility movement and its consequences for biological productivity. Evidence includes a class of Aboriginal artworks known as *Water Dreaming*, which depict the essential features of the chain-of-ponds structure and adjacent landforms. When overlaid with modern geomorphologic models, this suggests an ancient grasp of the essential

"Group of Aboriginals, Chowilla Station on the Lower Murray River", Charles Bayliss, 1850-1897. National Library of Australia. Source: https://commons.wikimedia.org/wiki/File:Group_of_Aboriginals_at_Chowilla_Station_on_the_lower_Murray_River,_South_Australia_(6174049594).jpg

physiognomic form for riparian sustainability [7]. This appreciation of holistic landscape function seems to have since been lost to much modern land and water management thinking.

From as early as a few decades following European colonisation of Australia, settlers started applying then-conventional Northern Hemisphere agricultural and pastoral practices, draining wetlands (pejoratively termed "bogs"), and dismantling the chain-of-ponds and swampy meadow forms [23]. This triggered progressive and serious landscape deterioration, including stream channel incision and widening, bed and bank erosion and general floodplain degradation. High stream flow velocities brought increased rates of sediment transport. Other impacts included the rapid run-down of surface water between high rainfall events, and high water salinity [24]. Most impacts can be attributed to human-induced ***geomorphic*** rather than climatic-change factors. Ironically, during the same 19th Century pioneering period, some of the new-Australian pastoralists recorded high primary productivity rates for their livestock and wheat. However it has since been recognised that such impressive productivity was largely the gift of free access to the millennia of stored fertility in the Australian landscape complex [23].

It has been estimated that, since 1788 when the first western-style farm was established by Englishmen around Sydney Cove, Australia's soils may have lost up to 80 per cent of their organic carbon content [25].

In common with many traditionally significant agricultural economies, the decline in broadscale soil condition and farm productivity in Australia has gathered pace to the present day [2]. Its deleterious effects on farmland production have been masked and moderated through successive technological advances in crop and animal genetics, widespread application of fertilisers, pest and disease management and targeted water infrastructure investments. But despite the promise of a technologically-driven second ***Green Revolution***, the biophysical capacity of Australia's landscapes to regulate their natural water and nutrient resources has been severely compromised. Ripl [26] characterises the inexorable downward spiral of landscape productivity in the following way: "…In terms of food production, self-organising landscape processes are replaced by agricultural practices oriented towards net output. Vegetation cover has been cleared, sub-surface water tables have been depleted and organic soil layers mineralised. The feedback control process of the water table through plant evapotranspiration has been interrupted. Thus, a short-term net productivity is gained at the cost of long- term landscape ageing…".

Whether this is an irreversible trend is the crucial question now facing landscape managers, farmers, rural communities and policy-makers alike.

Read more about Aboriginal use of Australian biomes and the increased recognition of Aboriginal agriculture and aquaculture:

- *Rethinking Indigenous Australia's agricultural past*. The Bush Telegraph May 2019 ABC Radio National – https://www.abc.net.au/radionational/programs/archived/bushtelegraph/rethinking-indigenous-australias-agricultural-past/5452454
- *Rethinking Indigenous Australia's agricultural past* (summary) News ABC
- *The Biggest Estate on Earth*, Bill Gammage
- *Dark Emu: Black seeds, agriculture or accident?* Bruce Pascoe
- *Using Dark Emu in the Geography classroom*, Simone Barlow and Ashlee Horyniak

Aboriginal biome use and management

Aborigines using fire to hunt kangaroos by Joseph Lycett, approx 1775–1828 (NLA NLA.PC-AN2962715-S20).

3 Innovations for landscape regeneration

3.1 Rethinking landscape management along ecological lines

A reappraisal is currently underway within Australia's modern farming context of the significance for sustainable landscape management of the fundamental biophysical processes that have operated for millennia [27]. A growing number of case studies is demonstrating that, by working ***with***, rather than against, the linked functional processes that sustained the Australian landscape prior to European settlement, productive farming, cropping and pastoral enterprises can be supported without degrading the system. It is thereby feasible to recover a version of landscape stability for our present age.

This approach is consistent with key ecological principles: accumulating, self- organising, building and localised cycling of nutrients, energy (carbon) and water. It recognises that plant-dominated landscapes can work against the degrading and essentially one-way forces of drainage and material export that characterise so much of 21st Century agriculture in Australia and elsewhere.

Hydrologically, this process involves the reconnection of stream waters with their adjacent alluvial groundwater systems, promoting a form of natural irrigation. This entails the use of subsidiary water courses and flow-slowing structures within streams to recreate sequential, stepped wetlands and high- productivity riparian vegetation zones. The resulting re-connection of surface and alluvial water flows converts degraded watershed landscapes from a "drainage mode" to a "natural storage mode", with streamside floodplains effectively becoming grass-covered water reservoirs. Importantly, the permanent, water-filled stream channel exhibits perched features – that is, becoming raised (by sometimes as much as 12 metres) above the alluvial floodplain itself – producing a hydrostatic head of fresh water that effectively prevents saline water intruding from the surrounding hillslopes [21]. Given the significant productivity impacts of salinisation of Australian soils, this feature has major implications for restoration of saline catchments.

Plants, as the natural drivers of terrestrial energy capture and distribution via photosynthesis and organic cycling, in their many and biodiverse forms, are an indispensable part of this process of restoring healthy landscape function. As well as providing an effectively zero-cost means of organic matter production, plants act as essential pioneer repair instruments by colonising the various niche habitats for nutrient and further biological aggradation.

3.2 The Natural Farming Sequence

The *Natural Farming Sequence* (or, in some publications, ***Natural Sequence Farming***) is a term coined by the Australian natural scientist Peter Andrews. Andrews has, for the past 40 years, been observing and interpreting the landscape rehydration process, and was awarded the Order of Australia Medal in 2011 for service to conservation and the environment through the development and promotion of sustainable farming practices [28]. He conceives the "sequence" of a sustainable landscape function in the Australian context as follows: "…In Europe, the sequence by which the landscape operates is seasonal. In Australia, the sequence is not nearly so regular and it is not determined by seasons. The basic factors that control this landscape are the carbon-processing green surface area of plants and the water cycle, operating together in an interrelated sequence of processes. The event that sets the sequence in motion is rain. The key principle is re-coupling of the carbon cycle with the hydrological cycle, which together have the capacity to promote landscape fertility, on the one hand, and to moderate climatic extremes through evaporation, on the other…" [29].

There are six underlying tenets and processes for the renovation of landscapes for sustainable farm productivity, as applied under the ***Natural Farming Sequence*** approach comprise (Table 1).

Table 1: Six underlying tenets and processes in the *Natural Farming Sequence*.

1. Centrality of local, daily water cycling

The repetitive, rapid cycling of water through evapotranspiration by intact vegetation (the "daily water cycle") supplies constant recycled water for ecosystem processes, while acting to limit fertility (nutrient and carbon) losses from the soil profile, thus arresting soil degradation [26, 30]. This is the only water a plant can receive that does not move environmental capital.

2. Landscape cooling

The dissipation of incoming solar energy through evapotranspiration and condensation of dew plays a significant role in buffering diurnal temperature extremes and moderating landscape and atmospheric warming [8].

3. Functional role for biodiversity

The proactive retention and recruitment of biodiverse flora and fauna in the landscape

enhances ecosystem function by, ***inter alia***, maximising leaf area index, promoting niche occupation for fertility build-up from the soil profile and from water-borne detritus, rapid nutrient recycling and repair of impoverished soil [31].

4. Salinity management

The reinstatement and maintenance of a surficial "lens" of fresh groundwater, under positive hydrostatic pressure, prevents saline ingress [32]. Active accession of soil organic matter also ameliorates existing surface soil salinity [33, 34].

5. Streamflow energy buffering and alluvial water recharge

Installation of low-cost kinetic energy dissipaters and sediment traps ("leaky weirs") acts to harness stream flood and fresh events for streambed rebuilding, re- establishment of chain of ponds configurations, and watering of floodplains [9, 35, 36].

6. Active production and redistribution of organic matter

Recycling of organic matter (carbon/energy and the associated nutrients) in landscapes is typically interrupted under human management by loss of natural herbivores and export of surplus site primary productivity as crops, forage, etc. Hence landscapes under active management for production typically require interventions that redistribute biomass from lower to upper slopes including careful grazing management [21, 28].

A late afternoon view of the Murray, between Wymah and Jingellic, from the NSW side. Source: https://commons.wikimedia.org/wiki/File:Upper_Murray_Stevage.jpeg

Advocates and practitioners of ***Natural Farming Sequence*** interventions highlight the importance of adopting an ***integrated*** ('holistic') approach to harnessing these vegetated landscape functions, as distinct from working in a ***reductionist*** fashion. Attaining sustainably productive landscapes will therefore not principally be delivered through hydrology alone, nor through pedology, nor biodiversity management, but through a careful optimisation of all these domains within the farming complex [37]

4 Case studies of Australian farm landscape rehydration

Recent years have seen a growing awareness and promotion amongst decision- makers of the elements and promise of the ***Natural Farming Sequence*** in Australia and other parts of the world. This includes scientific investigations of the efficacy of these practices in reversing the impacts of land degradation and of implementing cost-effective sustainable landscape management (Table 2).

Table 2: Examples of Australian landscape rehydration projects and benefits.

***Tarwyn Park*, Upper Bylong, NSW (32°26'56.6"S 150°08'59.1"E)**

- Significant reduction in stream and floodplain salinity, and reversal of valley salinisation; low dissolved salts indicating reduced export of site's nutrient capital [38].
- Increased pasture productivity and substantial agronomic and environmental improvements on the farm, with increased aquifer storage providing effective subsurface pasture irrigation; reduced velocities of stream and floodplain flow velocity, reducing channel incision and soil erosion; recreation of a "chain of ponds" system, colonised by dense reed beds; a sustainable farming system with very low inputs of chemical fertiliser through the effective internal cycling of nutrients [32].
- Major (positive) changes to soil chemical and biological properties [39].

***Baramul*, Widden Valley, NSW (32°33'09.2"S 150°21'35.3"E)**

- Considerably greater residual stream pool depths in cease-to-flow periods, with pool water storage volumes quadrupled, and an increase in aquatic habitat [40]; enhanced

stream bench development, with channel narrowing, accelerated by active recruitment of in-stream rheophytes such as ***Casuarina cunninghamiana*** [41]; enhanced localised channel-floodplain hydrological connectivity in coarse-grained sediments - important for restoring hyporheic function [24].

- Indicated improvements in soil organic matter levels & cation-exchange capacity [42].

***Mulloon Creek*, via Bungendore, NSW (35°16'32.6"S 149°34'10.8"E)**

- Progress on a series of research projects on 10,000 hectares of the Lower Mulloon watershed to reinstate alluvial hydration and to implement other sustainable farming practices [43].
- Significant reversal of channel and floodplain incision; reinstatement of chain-of-ponds system.
- Evidence that the project is "banking" water during higher flows and maintaining higher low flows when the weather is dry.
- Costs of flow-slowing installations assessed in terms of farm return [36].

***Spring Creek*, via West Wyalong, NSW (33°38'20.8"S 147°23'01.2"E)**

- Spring Creek was originally chain-of-ponds and swampy meadow complex. The installation of rock weirs and other intervention structures is designed to arrest channel incision and to functionally reconnect Spring Creek and its floodplain [44].
- The work has resulted in enhanced sediment aggradation, extending to up to 100m above installed in-steam weirs; overland flow dissipation in vegetated riparian zone with reduced lateral stream bank erosion [45].

There is a diversity of experiences of, and outcomes from, implementation of the principles of the ***Natural Farming Sequence*** in the above case studies. All warrant further technical evaluation of the long-term benefits of such interventions for enhancement of farm productivity and profitability. However there is already an emerging consensus amongst Australian landscape scientists and managers that the holistic ***Natural Farming Sequence*** approach can offer a low-cost, productive alternative to conventional high-input agricultural practices [9].

5 Landscape rehydration and climate moderation

In addition to enhanced benefits for productivity and ecological integrity of landscapes from rehydration interventions, there is evidence that mesic landscapes contribute to climate stability [8, 26, 30]. Two principal processes are in play, one at regional scale and one operating more locally.

At the regional scale forested landscapes contiguous with coastlines are thought responsible for "pumping" maritime moisture-laden air onto the land through evapotranspirational flux [22, 48]. It appears that complex natural forests with high leaf-area index will deliver the most precipitation via this 'biotic pump' mechanism, while sparser savannas will deliver the least [49]. Productive farming landscapes, including those rejuvenated by the types of interventions described earlier, which include extensive belts of upper slope closed-canopy forest, can be expected to have the potential to also contribute in this way.

The second, and perhaps more far-reaching, implication of rehydrated vegetated landscapes for climate moderation is their contribution to dissipation of incoming solar energy through the daily water cycle [8]. This cooling value of rehydrated landscapes, until now little acknowledged in mainstream climate science discussions, can be shown to be a far more significant contributor to climate moderation than sequestration of carbon dioxide [30]. Such a recognition adds a significant dimension to the opportunities landscape rehydration offer for Australia's and the world's farming future.

6 Conclusions

Researchers in parts of Europe have sought to apply the science of landscape rehydration to policy reform for management of farming, nature conservation and urban lands [50]. Mainstream Australian thinking and policy on integrated farm and landscape management still lags behind. However where a landscape rehydration management approach has been adopted in Australia it has delivered greater water reliability to farmers, improved soil organic content and reduced reliance on high-cost chemical inputs. The collateral benefits of biodiversity protection, reduced bushfire impacts, and buffering the impacts of climate extremes add significant weight to the urgency of progressing this opportunity.

The wider, informed adoption of interventions aimed at producing sustainable rehydrated farming landscapes, matched by priority legislative, promotional and market support, would provide a sound, low-cost basis for reversing landscape degradation across Australia and around the globe.

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INTRODUCTION: PICTURE YOU IN AGRICULTURE

Lorraine Chaffer, President GTANSW & ACT

After making her mark as an award-winning dairy farmer at Clover Hill Dairies on the NSW South Coast, Lynne Strong founded the Not for Profit charity **Picture You in Agriculture** (PYiA) to inspire young people to be the future of agriculture in Australia and leaders of sustainable agricultural industries.

"Picture You in Agriculture believes in attracting the best and brightest young people to agriculture. We equip them with the skills needed to navigate the world, give them confidence to share their stories and support them to take on leadership positions, all while contending with the many changes life will throw at them".

For 10 years PYiA have developed programs to connect farmers and the community including **Art4Agriculture** which has three signature programs; The Archibull Prize (secondary school), Kreative Koalas (primary schools) and the Young Farming Champions. The two school programs (for both rural and urban schools) combine art, agriculture, innovation & leadership to bridge the gap between agriculture, education & students.

In the Archibull Competition for example, students produce:

- Artworks on full sized fiberglass cows exploring Australian agricultural industries, the environmental issues that affect farmers, and the food and fibres produced.
- Multimedia animations exploring Agriculture.
- Blogs that map their journey towards gaining an understanding of agriculture in Australia – its triumphs and challenges.

The challenge for PYiA and A4A is making careers in Agriculture an appealing option for young people.

"For young people, 82% of careers in agriculture lie beyond the farm gate & our sustainable food future relies on them seeing careers in agriculture as attractive, viable & exciting".

In 2019, GTANSW & ACT selected Picture You in Agriculture as the focus of fundraising at the Annual Conference at Sydney Olympic Park, raising $1025 for the charity.

Read more about Picture You in Agriculture, Art4Agriculture, The Archibull Prize and challenges to the future of agriculture at:

http://archibullprize.com.au/about/index.html

https://pictureyouinagriculture.com.au/aboutus/index.html

Read more about Lynne Strong
https://pictureyouinagriculture.com.au/theteam/index.html

OPENING YOUNG EYES TO CAREERS IN AGRICULTURE

Lynne Strong, Art4Agriculture

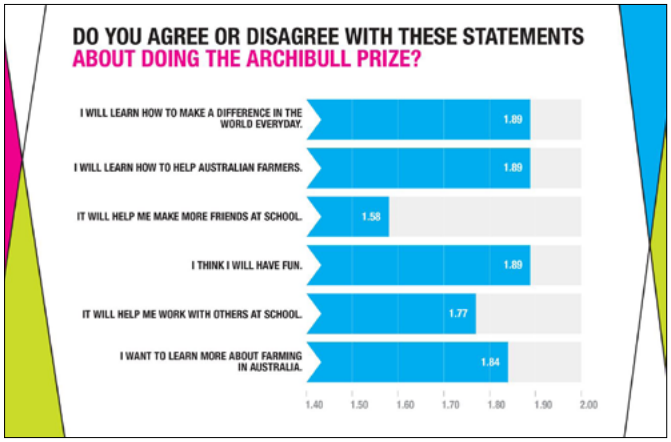
Opening young people's minds to the diversity of careers in agriculture that offer an opportunity to provide practical real world skills to solve real world problems and have a positive impact on the world is a key objective of The Archibull Prize and the Young Farming Champions programs.

Research shows the traditional source of inspiration for careers is family, friends, television celebrities and high profile sports people . Research also shows children leaving primary school have closed their minds to up to 70% of careers. Our challenge has been how to open their minds to be curious about the world of work and tap into what motivates young people .

Research shows young people highly value careers where they can make a difference The Archibull Prize entry survey question reinforces this desire.

In their January 2018 report Drawing the Future UK charity Education and Employers explored the career aspirations of primary school children from around the world: "Early intervention can be a very cost effective, targeted way of raising children's aspirations and broadening their horizons," the report says. "The evidence suggests that giving children the chance to meet volunteers from the world helps them to see the meaning and relevance of the subjects they are studying at school. Embedding experiences of the real-world in learning and the school curriculum can lead to increased motivation resulting in increased educational attainment."

The Archibull Prize and Kreative Koalas programs employ these strategies by assigning each school a Young Farming Champion (YFC), a young agricultural professional who is perceived as speaking from a vantage point of real authority as they earn a wage and grow a career within the industry.



We have found the YFCs also play a key role in providing young people with role models and tackling stereotyping around gender and ethnicity, which opens their eyes to possibilities not previously considered.

We have also learnt that offering a careers competition, in conjunction with The Archibull Prize, is a positive way to extend our reach and engage students not directly involved with the program. Our annual National AgDay Careers Competition asks students to identify their strengths and interests, choose a career in agriculture and research the educational pathway to that career. In 2018 over 30 entries were received for the competition from primary and secondary schools in urban, rural and distance education environments, and 22 unique careers were identified.

Samantha Wan with school students
Source: [gallery ids="13762,13763" type="rectangular"]

Elders wool broker and AWI YFC Samantha Wan is an example of the calibre of young professionals working with school students to encourage careers in agriculture.

Sam mentored students at Picnic Point High School in 2018 with The Archibull Prize and teacher Lisa Gourlay was particularly impressed.

"Sam arrived with three suitcases full of her own clothes that were made from 100% wool including shoes and

jackets. She came with loom and finger knitting and pom poms. She came with a ball of energy and was so genuinely passionate about sharing her career and this project. She really was an inspiration.

When we looked at what jobs were available in the sheep industry we were very narrow minded thinking of the farm and the sheep. Then we meet Sam who is beautiful and young, from Blacktown, who is now working across rural Australia and internationally." Lisa says.

The Archibull Prize use of entry and exit surveys of students and teachers allow us to monitor the impact our Young Farming Champions are having on the students they are building relationships with.

Within these surveys word clouds are used to collate responses. The following word clouds illustrate the change in agricultural career definition from the beginning to the end of the program.

Identifying the issue

The Archibull Prize entry surveys show students struggle to name a career in agriculture and only identify farming related activities

Identifying the messenger and what success looks like

The Archibull Prize exit surveys year on year highlight the impact our Young Farming Champions are having on the students

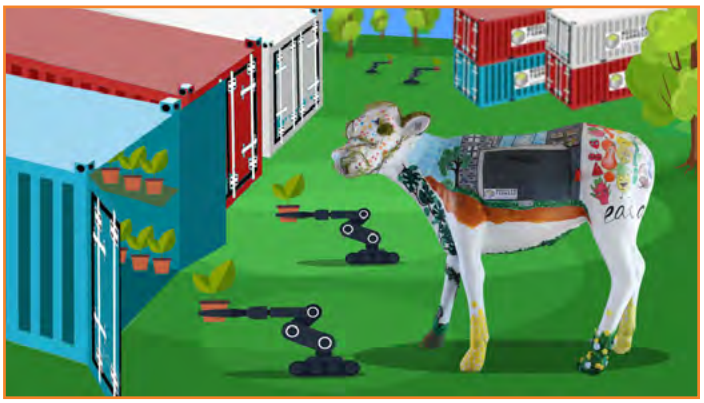
Teachers value The Archibull Prize for its capacity to provide students with the real world skills to be ready for the jobs of the future.

Join the team of teachers and students who are part of the solution. Expressions of interest are open for The Archibull Prize 2020, for further information contact Art4Agriculture National Director Lynne Strong at lynnestrong@art4agriculture.com.au

Above: GRAND CHAMPION ARCHIBULL 2018
Hurlstone Agricultural High School

Below: PRIMARY SCHOOL CHAMPION ARCHIBULL 2018
Gwynneville Public School

Archibull Prize – Hall of Fame.
Source: http://archibullprize.com.au/halloffame/index.html



Above: RESERVE PRIMARY CHAMPION ARCHIBULL 2018
Little Bay Community of Schools

PY IA! PICTURE YOU IN AGRICULTURE

OUR VISION

A national network of globally connected young thought leaders thriving in business and in life, who are inspiring community pride in Australian farmers.

OUR MISSION

To understand the challenges, support the needs and develop the skills, competence, and confidence of young people in agriculture to take an active role in decision making.

OUR GOALS

01

We create opportunities for young people to learn the skills needed to be adaptable and resilient in complex and changing times.

02

We transform young people to be empowered advocates and changemakers making a difference to Australian agriculture and how it is perceived by the wider community.

03

We amplify the youth voices of agriculture through our in-school programs:
The Archibull Prize and Kreative Koalas.

04

We showcase the diversity of careers and career pathway opportunities in the agricultural sector.

the ARCHIBULL PRIZE

KREATIVE KOALAS Design a bright future

YOUNG FARMING CHAMPIONS connect-collaborate

WWW.PICTUREYOUINAGRICULTURE.COM.AU
E: LYNNESTRONG@PYIA.COM.AU
M: 0407 740 446

OUR PROGRAMS

THE ARCHIBULL PRIZE

A world-famous program for secondary schools, which connects students and teachers with Australian agriculture and introduces them to young people working in the industry. The program takes life-size fibreglass cows into the classroom and inspires participants to feed, clothe and power a hungry nation.

KREATIVE KOALAS DESIGN A BRIGHT FUTURE CHALLENGE

A primary school program using the United Nations Sustainable Development Goals and a cache of community experts to assist students on a journey of sustainable living, while building collaborative partnerships with others in the community such as government, business and industry.

YOUNG FARMING CHAMPIONS

Young people working in the agriculture sector are trained, mentored and given skills under the guidance of some of Australia's top media, consulting and social licence experts. These young people then have the confidence to share their stories with schools, with community, with industry and with government.

YOUTH VOICES LEADERSHIP TEAM

An alumni of Young Farming Champions learning from their elders and from each other. Together they explore issues affecting leadership in agriculture such as its volunteering nature and how to balance leadership with education and family commitments. They then use their insights to support young agricultural professionals and mentor the next generation.

PICTURE YOU IN AGRICULTURE

GET IN TOUCH TODAY AND FIND OUT HOW YOU CAN PARTNER WITH US.

PLEASE CONTACT OUR PARTNERSHIP MANAGER LYNNE STRONG ON 0407 740 446 OR LYNNESTRONG@PYIA.COM.AU

Sustainability: Newcastle Grammar School's rooftop gardens

Drew Collins, GTA Councillor &
Head of Global Studies Faculty, Newcastle Grammar School

Compared with people living in many countries around the world, most Australians have very reliable access to a wide variety of different foods. Relatively high wages and a strong economy mean that most Australians can afford to purchase and prepare the food they need and rarely worry about where their next meal is coming from. (Collins et al : Oxford Insight Geography Stage 5, OUP 2016)

However, food experts are warning that famines are likely to become more severe and widespread as the Earth's climate changes and the human population continues to grow. An argument is also made that food security is the greatest single issue facing the world today. I would also include the associated water shortages in this debate too.

There are six main threats to food security: water scarcity; climate change; threats from non-native plants, animals and insects; competition for land; the use of land for fuel instead of food; and armed conflict. Although Newcastle Grammar School's (NGS) Roof Top Garden may not be able to resolve these issues, it does go a long way to bringing them to the attention of their students through both, the theory and hands on getting 'down and dirty', still within their concrete-based CBD playground.

The significance of the program:

- In taking on the responsibility for the stewardship of a number of bee hives, NGS students are able to learn about the pressures these important insects face.
- They see the unique way in which bees construct their home and engage with their local environment to survive.
- The program works in unison with a rooftop farming project as the students harvest food and seed that has been pollinated by the bees.
- From a wellbeing point of view, the program builds a sense of appreciation for the world around them and allows the students to practice mindfulness and flow while working with the bees.
- NGS expects to participate in a biosecurity screening program for varroa mite and other foreign honey bee pests.
- Stage 4 Technology Mandatory students will help care for the garden from 2019 onwards, as part of their agriculture unit of study.
- The obvious cross-curricular link is then with Stage 5 Geography students as they start to investigate Sustainable Biomes and Food Security.

Role and importance of bees in the environment:

- Bees are the sole pollinator for many of the introduced food plants we rely on.
- Their efforts in pollination contributes to food security by ensuring we can produce locally acclimatised fertilised seeds.
- This extends to non-edible plants also. Many of which rely on insect pollination to reproduce.

Rooftop garden and beehives create a buzz

NGS is taking learning to the top, with a flourishing rooftop garden opening up new learning experiences across a wide range of subjects, and students abuzz with enthusiasm for two recently established beehives.

Technology teacher Mr Chris Wyatt is leading the project that has not only seen the rooftop turned into a sustainable garden supplying fresh produce, but will foster the growth of Newcastle's bee population.

The rooftop garden was planted for the first time in 2018 and has produced vegetables to be used in Food Technology courses and the school canteen. The first crop was harvested in September last year, with a "mega cabbage" used to make coleslaw served on the baked potatoes being sold in the canteen.

From 2019, Stage 4 Technology Mandatory students will help care for the garden as part of their agriculture unit of study. And composting has also been added to close the energy loop for the garden. There are also plans for the future to have aquaponics incorporated into the garden – a self-sustaining system of growing fish in a symbiotic combination with plants.

Bringing cross-curricular links with STEM to life

Newcastle Grammar School has a strong focus on STEM education and a big part of this is looking at the processes around us humans and how energy is produced and utilised. Geography is used as the vehicle.

"The garden offers an exciting opportunity for students to have a real-world connection and one of the ideas already being discussed among students is the possibility to incorporate solar energy into the aquaponic system to run the pumps." Mr Wyatt said students were driving the garden's development, putting forward suggestions about how it is designed and what elements are incorporated.

"This project will help bring learning to life across a wide range of subjects, which we know provides students with skills that are not only critical to supporting future innovation in Australia, but are increasingly sought by employers regardless of the career pathways students pursue," Mrs Erica Thomas (Head of School).

NGS beekeeping programme has no sting in the tail

NGS students are now the proud carers of colonies of stingless bees, after two hives were installed on the rooftop of the city based Hill Campus. "We certainly need to protect our native bees, which face the threat of loss of habitat," Mr Wyatt an avid apiarist says. The students are managing the hives, which have a perspex lid enabling close monitoring of their development.

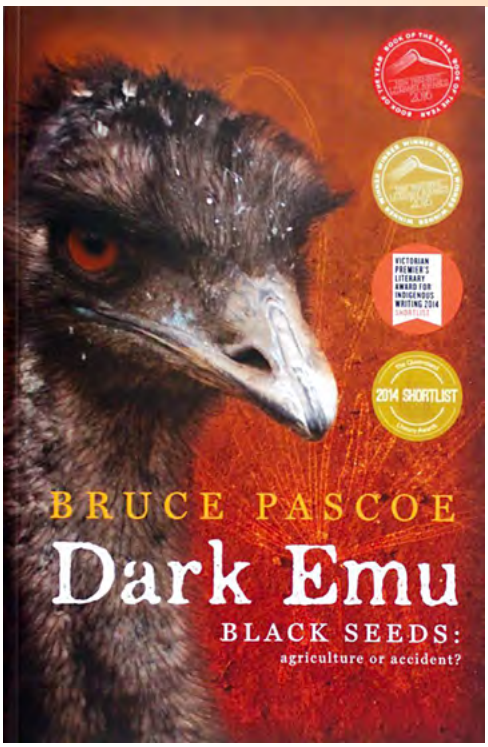
Beekeeping not only provides students with new experiences and skills, but can teach them how to work towards a goal, how to work in collaboration and show them the value of contributing to their community. The programme is in keeping with the school's Positive Education Framework, beekeeping and gardening were also great stress-relievers, encouraging mindfulness and focus.

"I have a passion for students learning self-sufficiency, but I think the most powerful aspect is really about student wellbeing. Students have the opportunity to interact with the environment, to slow down, and to take time to appreciate what is around them." Mr Wyatt says.

A parent wrote "What a great privilege to have such passionate teachers who want to share their skills, hobbies, knowledge and passion with the students and school community beyond their role as classroom teachers."

Maybe rooftop gardens and bee hives are a step too far for you as a Geography teacher. But what about a simple project like growing plants in recycled terrariums on your classroom windows? Or using old car tyres with some simple herbs or vegies in the corner of your playground? Maybe even revegetate your school pathways or roadside verge? Is cost a concern? Approach one of your local businesses and ask for an 'investment in educating local students'. Get involved and dirty!

Abstracts taken from Oxford Insight Geography Stage 5 (Collins et al, OUP, 2016) and Chris Wyatt (STEM Teacher, Newcastle Grammar School). Photos taken by Drew Collins and Chris Wyatt



Using *Dark Emu* in the Geography classroom

Simone Barlow and Ashlee Horyniak

Written for the Geography Teachers' Association of Victoria. Permission to reprint

Dark Emu: Aboriginal Australia and the birth of agriculture (2018) is a critically acclaimed book that re-examines the culture and society of pre-colonial Aboriginal Australians. Author Bruce Pascoe presents a logical and convincing argument for the presence of pre-European Aboriginal economy and, in doing so, challenges the notion that Aboriginal Australians were hunter-gatherers. His call for a revision of history is compelling. Using evidence from a range of sources, including the diaries of early colonists and explorers, Pascoe encourages readers to look beyond what they may have been taught at school or seen portrayed in mainstream media and question the dominant historical narrative as constructed by white Australians.

Figure 1: Dark Emu: Aboriginal Australia and the birth of agriculture by Bruce Pascoe

Pascoe explores multiple facets of Aboriginal society to portray a thriving pre-colonial civilisation. He points to the cultivation of the yam daisy as evidence of domesticated plants, the use of fire as a tool to promote natural regeneration and control the surrounding environment, and numerous examples of fishing techniques that were established well before colonists arrived.

Dark Emu is an important text, not least because it allows the inclusion of Aboriginal perspectives in the curriculum. It presents an alternative view of the past, bringing forward the voices of those previously silenced, while serving as a reminder for students that history can be presented differently as a result of different interpretations.

Dark Emu in the Classroom: Teacher Resources for High School Geography is a PDF and print resource which has been published to assist teachers using the concepts in ***Dark Emu*** in their teaching. This resource offers teachers a way to embed the Victorian Curriculum's Aboriginal and Torres Strait Islander cross-cultural perspectives in the subject of Geography.

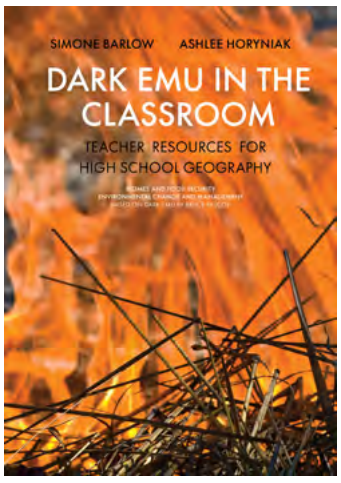


Figure 2: Cover of the teacher resource for Dark Emu in the Classroom: Teacher Resources for High School Geography

One challenge teachers often face is teaching cultures of which they have very little knowledge or experience. While it can be uncomfortable for non-Indigenous teachers to teach about Aboriginal and Torres Strait Islander cultures, it is better to try than not attempt it at all. One approach is for teachers to educate themselves as best they can, and ***Dark Emu*** is a fantastic place to start. Moreover, the inclusion of this text is one way of stopping teaching about Aboriginal people and start including Aboriginal perspectives across a range of topics.

Dark Emu in the Classroom: Teacher Resources for High School Geography presents curriculum content from an Aboriginal Peoples' perspective for the topics:

- Biomes and Food Security (Level 9)
- Environmental Change and Management (Level 10).

The lessons have been designed to be used individually or in a sequence. Teachers can select activities that are appropriate for their students. Differentiation options are included for less-able and more-able students. Activities have also been included that cover the capabilities that are transferable across disciplines: ethical, personal and social, critical and creative thinking and intercultural. There are also activities with a focus on both literacy and numeracy skills.

The following lesson is an excerpt from the forthcoming teacher resource book – ***Dark Emu in the Classroom: Teacher Resources for High School Geography*** (2019).

How have Aboriginal and Torres Strait Islanders changed biomes to produce food?

Learning intentions

For students to:

- analyse the impact that firestick farming has on the land
- challenge Western assumptions about fire.

Key inquiry questions

- What is firestick farming?
- What are the consequences of firestick farming on the land?
- How have people changed biomes?
- Should firestick farming be adopted as a method of managing the landscapes of rural Australia?

Key vocabulary

Firestick farming, terrestrial biomes, cultivated, controlled burns.

Time required: 45 minutes.

Materials

- Handout 1: ***Dark Emu*** **Synopsis – Fire** (one per student).
- Handout 2: **Anticipation Guide** (one per student).
- Handout 3: **How have Aboriginal and Torres Strait Islander people used fire as a tool?** (one per student).

Teacher instructions

Prior knowledge

It is expected that students have learnt about:

1. The characteristics of major terrestrial biomes across Earth.
2. The range of biomes in Australia.

Starter

1. Distribute **Handout 2: Anticipation Guide** to students to complete individually. They should respond to each statement, indicating whether they agree and write down the justification for their thoughts. You may wish to explain that these statements will preview the content of the day's lesson.
2. Discuss student answers as a class.

Main activity

Distribute **Handout 1:** ***Dark Emu*** **Synopsis – Fire** and **Handout 3: How have Aboriginal and Torres Strait Islander people used fire as a tool?** Ask students to complete the reading from ***Dark Emu*** and then the question sheet. Tell students to discuss and infer the disadvantages of using firestick farming.

Plenary

Ask students to return to their ***Anticipation Guide*** and reflect on their initial answers. Ask which, if any, responses have changed.

Differentiation

For less able students:

- ask students to define bolded words before reading the synopsis
- instruct students to work with a partner to complete the advantages and disadvantages of firestick farming (Q4 of handout). Assign one side to each partner then swap answers to complete the question.

For more able students:

- extend understanding by further discussing the concept of farming by distributing the article: http://www.theguardian.com.au/story/936405/the-first-farmers
- extend understanding by researching the question: did firestick farming contribute to the extinction of megafauna?
- analyse the use of firestick farming as a land-management tool, using SHEEPT factors (social, historical, environmental, economic, political, technological).

Suggested adaptations

To support kinaesthetic learners, the anticipation guide can be conducted as a whole class activity. Label each corner of the room as SA, A, D, SD (Strongly Agree, Agree, Disagree, Strongly Disagree) and ask students to move to the corner that represents their response. Then ask one representative from each corner to explain their thinking.

Please contact Magabala Books at marketing@magabala.com for all enquiries about purchasing this classroom resource.

Simone Barlow completed her undergraduate studies at Sydney University, focusing on Human and Environmental Geography. After living abroad and travelling the world, completing her DipEd at Melbourne University. She has experience with both junior and senior Humanities, and is currently teaching at Williamstown High School at the senior campus.

Ashlee Horyniak completed a Bachelor of Arts with first class honours. Her minor in History focused on Aboriginal and Torres Strait Islanders through an anthropological and historical lens. She later completed a Master of Education at Melbourne University. She is currently Humanities Coordinator at Williamstown High School (Victoria) Bayview Campus where she teaches English and Humanities.

Dark Emu teaching resource

Handout 1: *Dark Emu* Synopsis — fire

The use of fire has always played a central role in Australia's culture. Whilst fire is often viewed in western society as a threat or danger, Aboriginal Australians hold a very different perspective. Some evidence suggests that Aboriginal Australians began using fire as early as 120,000 years ago, and researchers' question whether its use contributed to the extinction of Australia's megafauna.

Fire is a tool which, when used responsibly, aids in the creation of a landscape that sustains life. One important way that Aboriginal Australians use fire is a practice called firestick farming. This involves planned and controlled burns of lower intensity in order to manage the flora and fauna within a biome. This approach to fire worked on five principles:

1. The majority of lands were rotated through in patches or a mosaic pattern, to allow plants and animals to survive in those areas not being burned.
2. The timing of the fires was adjusted throughout the year, according to the type of country to be burned and the condition that it was already in.
3. The weather conditions were strictly considered.
4. Neighbouring clans communicated, advising each other of any fire activity.
5. The burns were not to occur during the growing season of any plants.

Due to these principles of rotation, the land was cultivated into a pattern much like a mosaic, with sections of both cleared land and forest. Firestick farming provides a method for regulating and managing the natural environment in order to maximise food resources. Better soils, produced after a burn, were used for food production while the inferior soils were left for forest. The preparation of soil is considered a signifier of agriculture. It is important to recognise that this practice has had a significant impact on Australia's vegetation. Most obviously, Australia's grasslands increased. This became a way to control where animals would congregate to improve hunting and protect deliberate plantings from hungry animals. In turn, it marks a shift away from hunting big game and toward a reliance on cultivating grains and tubers, like the yam daisy. A possibly more recognised advantage of firestick farming is the prevention of wildfires. When Aboriginal people were prevented from using this knowledge, underlying vegetation grew out of control and many native species suffered.

Native Yam Daisy or Murnong

Source: Adapted from Pascoe; B. (2018). ***Dark Emu: Aboriginal Australia and the birth of agriculture***, pp.161–176.

Dark Emu teaching resource

Handout 2: Anticipation Guide

Mark your opinion according to how strongly you feel and then provide an explanation of your thinking in the space provided. SA: Strongly Agree A: Agree D: Disagree SD: Strongly Disagree

Statement	SA	A	D	SD	Explanation
Fire is dangerous.					
Fire should be considered a form of technology.					
Fires cause devastation to the landscape and should be avoided at all cost.					
Farming requires the planting of crops.					
When Europeans arrived, the landscape was dominated by trees and thick bush.					
The land as it was when Europeans arrived should be considered untouched and unmanaged.					
Australia's biomes remain constant over time.					

Dark Emu teaching resource

Handout 3: How Have Aboriginal and Torres Strait Islander people used fire as a tool?

After reading the synopsis for Bruce Pascoe's ***Dark Emu***, answer the following:

1. In what ways can the Aboriginal and Torres Strait Islander peoples' use of fire be considered an agricultural practice?

2. If technology is defined as the application of scientific knowledge for practical purposes, do you think fire can be considered a form of technology?

3. In what ways has firestick farming changed Australia's biomes?

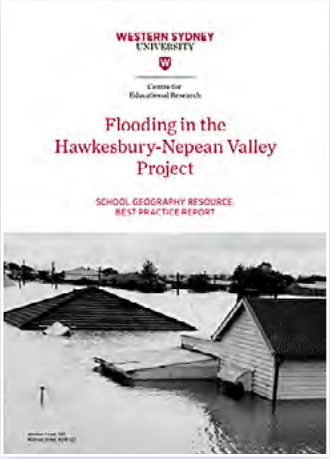
4. What are the advantages and disadvantages of firestick farming?

Advantages	Disadvantages

5. What aspects of contemporary life might present a challenge to the adoption of fire as a tool today?

Water in the World – A new digital resource

Western Sydney University with INSW and NSW SES, is developing a set of digital resources for the study of Stage 4 *"Water in the World"*. The project uses the lens of flooding in the Hawkesbury-Nepean Valley as the major case study for this topic. The resource is targeted at school students in order to help them understand the risks and potential impact of flooding in the overall picture of management of water.



The Project

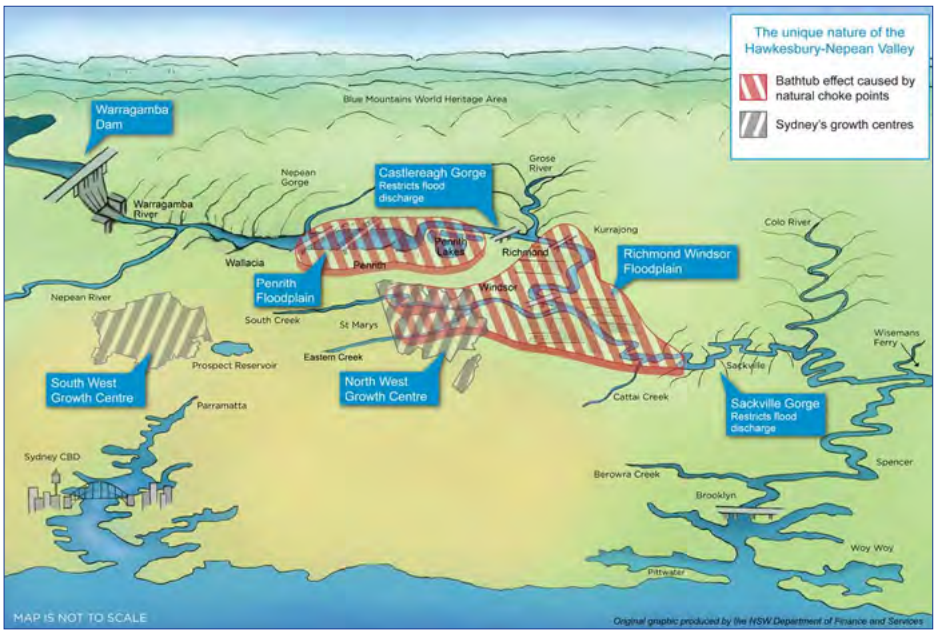
Unit of work and resources are currently in draft and will be further developed over the coming weeks. This is a cross-sectoral school project, ***due to be trialled with Stage 4 students and teachers in Term 3, 2019 and officially launched in Term 4.***

It is a cross-sectoral schools project, which will include **FIELDWORK, INQUIRY BASED LEARNING, PROBLEM BASED LEARNING, GEOGRAPHICAL SKILLS, CASE STUDIES, CURRENT DATA** and will launch with ***NESA Accredited Professional Development*** for teachers in Term 4.

Teachers and schools in the Hawkesbury-Nepean Valley area will be invited to attend the launch, and funding will be available for teacher Professional Development on how to use the resources. *Teachers from Hawkesbury-Nepean Valley schools will be eligible for paid release to attend.*

School Nomination

We seek interest from a range of schools in the Hawkesbury-Nepean Valley catchment, from Government and Non-Government sectors, to engage with trialling these resources. You are kindly invited to nominate your school to work with WSU on the trial for this important project, which is also supported by the Department of Education (NSWDoE), Catholic Schools NSW (CSNSW) and Association of Independent Schools of NSW (AISNSW). It is anticipated that participation will be beneficial to schools, as they will have exclusive access to quality learning materials endorsed by NSW SES. Western Sydney University (WSU) will also work with schools to ensure teachers are fully informed and supported throughout the trial.



For more information about the project, or to participate in the Stage 4 trial email Project Lead Dr Kay Carroll k.carroll@westernsydney.edu.au or Research Project Officer: Sasha Jessop s.jessop@westernsydney.edu.au

WESTERN SYDNEY UNIVERSITY

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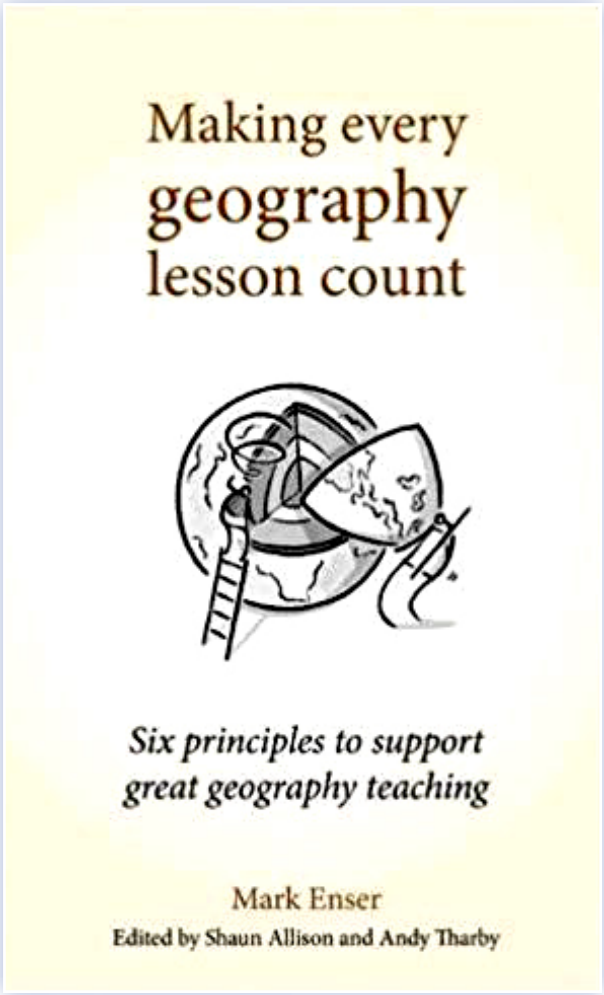
SES NSW STATE EMERGENCY SERVICE

Making every Geography lesson count

Mark Enser

Newly qualified and experienced teachers can gain fresh insights into geography teaching practise from this very readable and informative book.



The author clearly communicates a range of effective teaching and learning strategies using exemplars and detailed topic examples. The advice is thought provoking and encourages effort towards planning a challenging curriculum using six guiding principles: challenge; explanation; modelling; practise; feedback and questioning.

As I prepare for a new term's teaching, the key messages that I have taken away from reading ***'Making every geography lesson count'*** are around effective modelling techniques and a more careful and deliberate approach to 'practise' in classroom lessons. Suggested feedback and marking approaches and clarifying the purpose of 'question' within the classroom also provided opportunity for me to reflect on current practise.

I highly recommend this book for all geography teachers looking to make their lessons more meaningful and engaging. Practical strategies aim to ensure students make links between content and ensure students 'think geographically' to deepen their ability to understand real-life application of knowledge and understanding. Many of the contributions by experienced teachers may be useful to those teaching geography for the first time or looking for a new approach to their instruction.

As an experienced teacher of geography, I found this book provided a fantastic professional learning opportunity. I am impressed that this small book is written by practising geography teachers keen to share elements of best practise with other geography teachers.

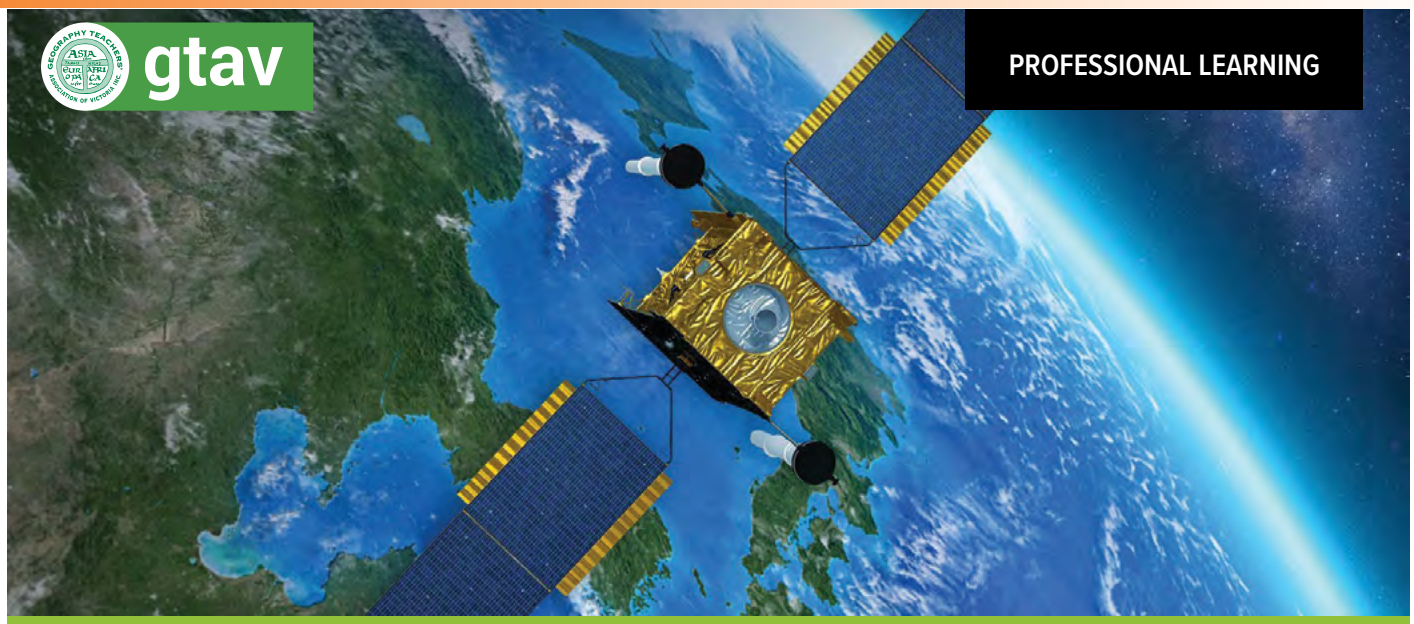
Reviewed by Karen Bowden
Experienced Geography teacher and GTA NSW & ACT Councillor

" .. Mark Enser maps out the key elements of effective geography teaching and shows teachers how to develop their students' conceptual and contextual understanding of the subject over time.

Making Every Geography Lesson Count is underpinned by six pedagogical principles – challenge, explanation, modelling, practice, feedback and questioning – that will help to ensure that students leave each lesson with an improved knowledge of the world, a better understanding of how it works and the geographical skills to support their learning "

Andy Buck, Honorary Vice President, Geographical Association.

Above: Back of book testimonial



Spatial technology online course

JUST RELEASED

The GTAV has developed this ecourse to help you develop your spatial technology skills regardless of your level of expertise in the field.

Are you new to spatial technology? OR **Are you ready to expand your spatial knowledge?** OR **Do you want to refine your spatial skills even further?**

Once you enrol in this course, the content is available for you to access at any time. You choose when, where and how much you wish to use.

This course provides instructional material on the use and application of spatial technology tools including:

- Survey 123
- ArcGIS online
- Story Maps
- Google Maps
- Gapminder
- Earth Observatory

Includes 25 instructional video clips – with ongoing access.

To receive a certificate of completion, there are a minimum number of required tasks.

Estimated 20–25 hours to complete the minimum number of required tasks.

This is Module 4 of the Certificate of Geography Competency – there is no requirement to complete the other modules in this set.

MEMBERS
$200 per course/module

NON-MEMBERS
$250 per course/module

FURTHER INFORMATION
www.gtav-ecourses.asn.au

This program is supported by the Victorian Government – SPP program.

VICTORIA State Government

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2019 ANNUAL CONFERENCE REPORT AND FEEDBACK

Photo: L Chaffer

Lorraine Chaffer, President GTANSW & ACT

I am very happy to report on the success of the GTANSW & ACT 2019 Annual Conference. This is the largest event in the GTA calendar each year made possible through many hours of hard work by GTA NSW & ACT Council volunteers and the Professional Teachers Council NSW (PTC NSW) administration. The venue at ANZ Stadium provided opportunities not available at previous venues as well as room for an increased variety of trade displays, many new for 2019. For the first time there were THREE EVENTS within the 2-day conference program, The Place of Geography two day 7–12 Conference, the Primary Twilight Workshop and the Awards Ceremony.

To our conference sponsors a big thank you for your generous financial support and contribution to the trade display and conference presentations. Sponsorship made it possible to invite presenters from across Australia including Keynote speakers Anika Molesworth (Broken Hill) and Dr. Karen Joyce (Townsville), TAFE NSW (Wagga), The Mulloon Institute (Braidwood) and Contour Education (Brisbane). Full and part day immersion courses such as Drones in Geography, A Day in the life of a Geospatial Scientist and The Mulloon Institute were made possible through sponsorship.

- GOLD sponsor LANDCOM
- BRONZE sponsor Sydney Olympic Park
- BRONZE sponsor NSW National Parks and Wildlife
- BRONZE sponsor Mobile Muster
- Teacher Scholarship sponsor Selective Tours.

Finally, a big thank you to all of the presenters who made for an interesting and varied program with a lot of choice for participants with 5 or 6 options in each session.

A special thank you to the presenters and participants who attended the Primary Twilight Workshop on Monday afternoon and the Awards ceremony on Tuesday.

Feedback from participants clearly showed appreciation for the selection of Keynote speakers on Monday and the Innovation and Sustainability panel on Tuesday. It is clear that NSW Geography teachers like listening to and discussing with practicing classroom teachers.

Tuesday's Innovation and Sustainability Panel. Presenters from the left Professor Alex McBratney (Sydney University and Sydney Institute of Agriculture), Dr. Maria Vozzo (Macquarie University) and SIMS, Dr. Louise Crabtree (University of Western Sydney and Hack4cities) and Cara Bingham (Landcom).

Feedback has been mostly very positive with an average score of 4.5 out of 5 on the venue, organisation, program, presentations and workshops.

A selection of participant highlights:

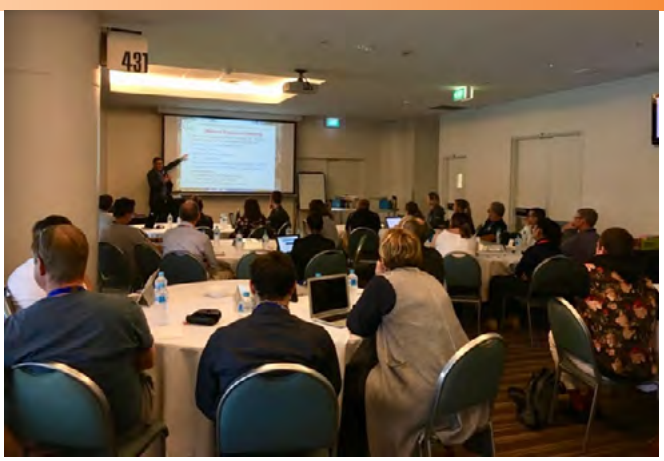
- The Welcome to Country and the two keynote speakers.
- Having a long time to learn some skills rather than only 1 hour sessions
- Keynotes and networking with colleagues
- One day sessions. In the past I have got a lot from the conference but then found it difficult to implement back at school. By focusing on one thing for the day (spatial technologies), I got a lot cemented in my mind and am planning to incorporate it next term.
- The AR/VR workshop was excellent – I could do that workshop easily for a whole day
- All the presenters on both days were excellent,
- The range of presenters and the workshops plus the addition of the get together opportunity at night (bar and restaurant) – nice to network socially as well
- The Sydney Water workshop was excellent in delivery, content and relevance. Louise is to be commended on her knowledge and ability to engage the audience as well providing practical ideas that can easily be transferred tot he classroom.
- Flying Drones and learning how to incorporate them into our Geography Programs
- The full day Drone workshop was an excellent mix of information and practical
- Natural sequence farming presentation – The Mulloon Institute
- Keep up the good work and creatively seeking experts in the field and great workshops- the variety from year to year has been amazing and keeps it engaging and challenging.
- Meeting other teachers and gaining new skills and gathering and sharing resources

Suggestions for improvement

- Perhaps provide more networking opportunities to enable teachers to meet other teachers from their regions. As a first time attendee, from regional NSW I found it difficult to find the other regional teachers.
- More of the day long programs.
- Have some repeat workshops as I can only attend on the one day.
- Maybe move to an easily accessible location like Parramatta. Public transport to Homebush is hideous.
- More teachers presenting on what they are doing in class.
- During the Panel Q & A, could you have a microphone so the audience can hear the questions.
- No improvement necessary. Continue with a mix of presenters for a variety of interests
- Perhaps a resource swap or round tables to discuss successes and challenges of 7-10 concepts, topics and case studies.
- It would be helpful if the entrance was near the station and bus stops.
- Parking to be provided.

All suggestions will be considered when planning the 2020 conference.

In the full day Immersion program run by TAFE NSW, Drones in Geography, participants learned to fly drones within ANZ stadium.



Luke Peel from The Mulloon Institute discussing Regenerative Farming, one of the very popular sessions

KEYNOTE SPEAKERS

Anika Molesworth (Farmers for Climate Action)
"Cultivating bright futures"

As a farmer, Anika Molesworth understands many challenges facing farmers including increasing populations, ecosystem degradation and climate change. She is a passionate advocate for sustainable farming, environmental conservation and climate change action. Anika's achievements to date are admirable, including:

- 2015 Young Farmer of the Year,
- 2017 NSW Finalist for Young Australian of the Year, and most recently...
- The 2018 NSW Young Achiever Award for Environment and Sustainability
- Founder of Farmers for Climate Action and the platform Climate Wise Agriculture
- Manager of the International National Trusts Organisation's Sustainable Farms program

Feedback from participants:

- Great engaging speaker, encouraging to see the future generation as passionate about the future as we are
- Really excellent. So many good links with different parts of the curriculum.
- She was fantastic and inspiring, I hope to link in somehow with her organisation when I next teach Year 9 Sustainable Biomes
- Excellent, really found this interesting and engaging
- I loved this! Anika was an engaging speaker and I would love to have her speak to our students!

To learn more:

- Watch Anika's conference keynote presentation "***Cultivating bright futures'*** using this link – https://vimeo.com/334800840
- Read the article in this edition '***Farming on thin ice'***
- Visit the Farmers for climate Action website https://www.farmersforclimateaction.org.au

Anika Molesworth sees a positive future for Australian agriculture if climate changes is addressed.

Den Barber (Koori Country Firesticks)
"Aboriginal Cultural Burning"

Koori Country Firesticks Aboriginal Corporation (KCFSAC) strongly believe that the revival of Aboriginal Cultural Burning knowledge and practices can help us address some of the issues and threats that wildfires present in South East Australia. They believe that considering a community driven model that is founded on Aboriginal culture, knowledge and traditional practice has many multi layered benefits for both Country and people. In his presentation Den Barber explored what the term cultural fire actually means and how it may be incorporated into contemporary land and bushfire management practices.

Feedback from participants:

- Loved it – so much I didn't know - gave me info readily applicable to my classes.
- So interesting to see this in practice- I think we need to be more actively involved in supporting this on a national level so that the cultural knowledge is not lost.
- Den was amazing, he has already helped me with fine tuning my stage 6 management strategies in EAR.
- Great to see more discussion about cultural burning. Also fantastic to hear language
- Interesting.
- A fascinating talk!
- I liked this as it another example of how aboriginal knowledge can be used to solve today's issues
- Such an insightful presentation from a passionate speaker. The information he (Den) could provide on the actual process particularly the after fire effects was very insightful.
- Great to see aboriginal customary practices having such a positive impact on communities. I'm using in class already.

To learn more:

- Watch Den's conference keynote presentation *"Aboriginal Cultural Burning"* using this link https://vimeo.com/334800905
- Visit the Koori Country Firesticks website www.kooricountryfiresticks.com.au/home.html

Den Barber after a 'cool burning' event in NSW.
(Source: Den Barber PPT Presentation GTA NSW & ACT Website)

Participants coding devices to fly micro-drones over a disaster zone in the She Maps semi-immersion session by Dr. Karen Joyce.

Dr Karen Joyce (She Maps and James Cook University)

Dr Joyce gave the careers presentation *"The place of Geography in past, present and future careers"* and the practical workshop *"A Day in the life f a Geospatial Scientist"* in which participants learned how to fly micro drones and discuss how to incorporate drones into Geography classroom practice.

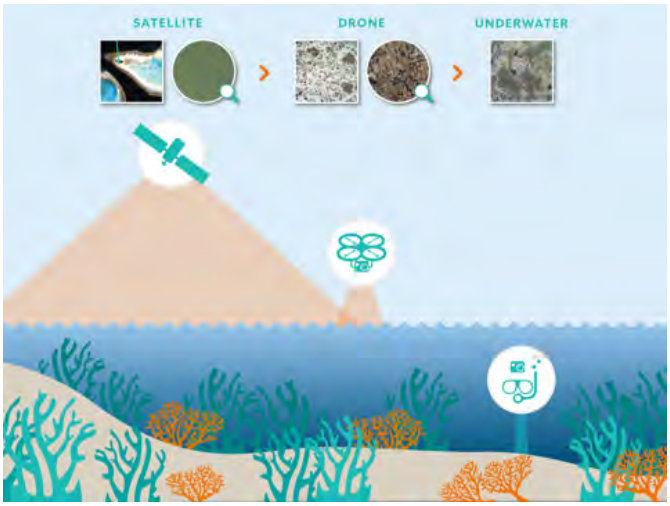
Dr Joyce has a PhD in Geographical Sciences (University of Queensland) where she focused on mapping live coral cover using remote sensing. Using her geographical and remote sensing expertise, Karen has worked in the Australian Army, developed models to map recreation opportunities across New Zealand's conservation estate, and integrated remote sensing into all phases of the disaster management cycle. She is heavily involved in integrating drone technology into remote sensing practice and tries to find ways to use remote sensing to make mapping easier. Karen is a Senior Lecturer in Remote Sensing and GIS at James Cook University in Cairns as well as the founder and Education Director of She Maps.

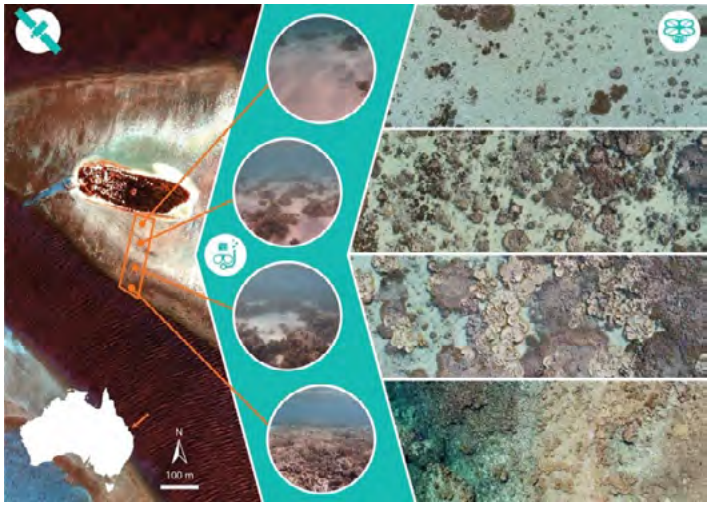
Feedback:

- I'm using in class already.
- Excellent, I amassed resources for the classroom
- Karen did a great job showing how drones are beneficial to geography, but the importance of data analysis and how geography relates to many careers.
- Interesting to find out more about 'She Maps' and how Karen is using drones for research as well as encouraging students in the classroom.
- Excellent
- Made me wish I could go back to Uni!
- Some great skills that students will be able to use.

To learn more:

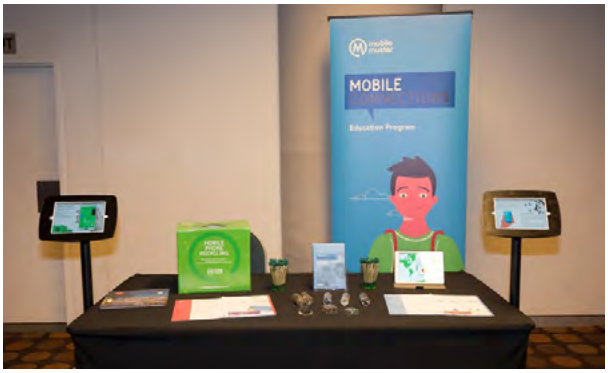
- Watch Karen's Careers presentation using this link https://vimeo.com/334800986
- Read the report on *"A Day in the life f a Geospatial Scientist"* in this edition
- Visit the She Maps website https://shemaps.com and undertake online professional learning for integrating drones into the curriculum.





Dr. Joyce conducts research on Heron Reef where she works with satellites, drones and underwater imagery to map different habitats on the reef. Drones are the new tool helping in the translation of in-water to outer space photographs as seen in this image.

CONFERENCE SPONSORS AND EXHIBITORS



At left: New sponsors and exhibitors for 2019 – NPWS Education, Mobile Muster and Selective Tours

Above: One of the GTANSW & ACT / Selective Tours TWO Scholarship winners, Kay Dunbar at left.

FROM THE 2019 ANNUAL CONFERENCE

It's not about the drones

Louise Swanson, GTA NSW & ACT Councillor

This article is a description of a workshop session presented at the GTA NSW & ACT Annual Conference 2019 by Dr Karen Joyce, She Maps/ JCU

Dr Joyce has a PhD in Geographical Sciences from the University of Queensland (2005) where she focused on mapping live coral cover using remote sensing. She is a Senior Lecturer in Remote Sensing and GIS at James Cook University in Cairns, as well as the founder and Education Director of She Maps.

Drones are unmanned aerial vehicles, navigated from the ground via control that can carry a camera (or other small objects). They provide students with a bird's eye view of geographical features, to aid in the exploration of geographical issues and spatial data analysis. Developing skills in using drones and analysis of associated spatial data helps student develop workplace skills and capabilities for future employment, and well as address the spatial technologies components of the Geography syllabus.

Microdrones mission

The session was built around a challenge to examine the impacts of extensive rainfall on a geographical region, and to help local authorities to determine the location and extent of damage. In this session Parrot Mambo Minidrones were used to capture aerial photography over a set range.

Drone safety

An important consideration of using drones with a class is safety. A teacher should lead students through a safety briefing that examines safety to self, others and the drone itself. This must be done before the students start to fly their drones. There is legislation now dictating the use of drones, but flying of drones less than 2kg doesn't require a license.

Key safety messages are:

- Keep your distance – stay 30 metres away
- Wear glasses and keep your face away
- Tie your hair back
- Never fly over the top of people in case it crashes

Group roles:

Place students into groups of three to complete the task.

- Pilot in charge – fly the drone, assess danger, focus on safe operation
- Co-pilot – big picture safety, monitoring the battery
- Chief Reporter – takes notes, photos, completes sketches

Drone flight modes

The drones work in two different modes. Manual flight mode and automated flight mode. Students need to practice flying the drones manually. Drones are paired with a tablet with has an app that controls the drone. The app is simple to use and has an automatic landing button. Manual flying skills to be developed include moving the drone in different directions, turning the drone and moving the drone higher and lower. Teachers need to direct students to focus on their skills in precision and accuracy, rather than speed. Skills in manually flying the drones are important in case the drone behaves unexpectedly when in automatic flight mode. Group members take turns in practising to fly the drone.

Automated flight mode uses coding to allow the drones to follow a set flight pattern (to complete an aerial survey). Tynker is an app that allows students to use simple coding to automatically fly their drone. The workshop participants were able to master the simple coding required in a relatively short period of time. To practice, a large map printed onto material was used to provide a field study area for the workshop. Participants were required to code their drone to undertake a survey of the area. They needed to move back and forward in a "lawnmower pathway" and take photographs at various locations to complete their survey. The photos would then be "stitched together". Participants trialled their coded, automated flight paths and then revised and re-trialled. Photos were downloaded for analysis.

Hints and tips:

- Always use the smallest drone possible – this reduces cost and risk of injury
- Don't be concerned about the level of skill required. Students may overtake the teacher's skill level but they will develop their skills quickly and will be able to achieve the outcomes of the lesson without too much teacher technical assistance.

Shemaps

For further information view the She Maps website: https://shemaps.com/

What makes a Geography assessment geographical?

Susan Caldis Vice President GTA NSW & ACT;
PhD Candidate, Macquarie University

Abstract

This article is based on the content and discussion from a workshop presented at the GTANSW & ACT Annual Conference in April 2019. The original intention of the workshop was to explore and reflect on: (i) the constructive alignment of assessment tasks in a teaching and learning program for Geography; and (ii) the provision of timely, useful feedback and feedforward using the *ANU and MQ Feedback for Learning Coffee Course* blog as a guiding structure. However, as planning and preparation for the session developed, the focus shifted. Whilst constructive alignment, feedback, and feedforward were still addressed in the workshop, they became contextualised through asking 'What makes a Geography assessment geographical? Workshop participants were invited to consider the overarching question to help them drill down in to the geographical knowledge, understanding, tools and skills deemed to be important enough to be assessed. The article covers selected points from the workshop including a series of thought-provokers for personal reflection, and an overview of emerging research from the pool of literature around geographical assessment. If you are interested in learning more about what makes a Geography assessment geographical I encourage you to read the 2018 issue of *Geographical Education: Assessment in Geography* available via www.agta.asn.au under the Resources tab, or enrol in the webinar scheduled for Wednesday 7 August, or consider attending the AGTA Conference in October and sign-up for the workshop.

A thought provoker for personal reflection

(Authors' photographs and collage)

Focus on one of your Geography classes and a particular unit of work. With those students placed at the centre of the relevant teaching, learning and assessment program, consider the following questions and write down your responses:

1. What do I want my students to be able to know, do and understand that is *distinctly geographical* by the end of [insert timeframe for the program]?
2. How will I know when students have achieved this or are working towards its achievement?
3. How will the students know when they have achieved this or are working towards its achievement?
4. What makes my Geography lessons in this program *distinctly geographical*?
5. What makes the assessment activities in this program *distinctly geographical*?

An overview of the literature

Drawing from selected Australian and international studies about the effective assessment of Geography in a secondary school context, it is evident that alignment needs to occur between what is valued in the Geography classroom that is *distinctly geographical*, and the purpose and outcomes of assessment within the school. To encourage development of constructive alignment between what is valued, taught and assessed in from a teaching, learning and assessment program in Geography, the following points emerge:

EFFECTIVE ASSESSMENT IN GEOGRAPHY	REFERENCE
Formative and summative approaches are required but need to be focused on cognition ***and*** meaningful geographical learning including conceptual, contestable and theoretical content. Formative assessment practices have been shown to enhance student engagement in Geography lessons ***and*** allow teachers to demonstrate their depth of knowledge about Geography	(Bijsterbosch, van der Schee, & Kuiper, 2017; Lane & Bourke, 2019; Solem, Stoltman, Lane, Bourke, Chang, & Viehrig, 2018)
Formalised and purposeful diagnostic assessment around alternative conceptions throughout a teaching, learning and assessment program. Such as strategy helps teachers to determine the nature and extent of conceptual change occurring student learning. Furthermore, results from diagnostic assessment become a source of feedback to teachers about the effectiveness of the program and provide a chance for constructive alignment between teaching, learning and assessment to be enhanced. Additionally, levels of required complexity or simplicity in instruction can be determined from diagnostic assessment and monitored throughout a learning progression.	(Lane & Caldis, 2018)
Spatial reasoning needs to be evident in formative and summative assessments, and become a benchmark for complexity of thinking. Spatial reasoning can be assessed through a taxonomic assessment tool such as SOLO. Spatial reasoning can also be utilised as a strategy for assessing the ability of students to analyse content and apply learning to the key concepts of Geography.	(Bijsterbosch, van der Schee, & Kuiper, 2017; Lane & Bourke, 2019)
Active construction of knowledge using prior and new knowledge provides opportunities for rigorous assessment in Geography and for teachers to determine how students are progressing in their geographical knowledge, understanding and application skills. Active knowledge construction activities are those which allow students to apply, integrate, create and evaluate procedural and conceptual knowledge in accompaniment to core knowledge. Examples of such activities include concept mapping, sketch-mapping, word-associations, interpretation and development of visual representations and diagrams.	(Bijsterbosch, van der Schee, & Kuiper, 2017; Lane & Bourke, 2019)
Demonstration of **multiple perspectives** needs to occur in formative and summative assessment. Perspectives could include communication about the global relevance of an issue or range of issues, and a process or range of processes across a variety of scales. Perspectives can also be assessed through active citizenship and the application of knowledge, skills and capabilities to a given context.	(Solem, Stoltman, Lane, Bourke, Chang, & Viehrig, 2018)

The relationship between a geographical Geography lesson and a geographical Geography assessment

The pedagogy of Geography is distinctive and our teaching practice in the Geography classroom should leave our students and visiting colleagues in no doubt that they have been participating in or observing a Geography lesson. Evidence from GEOGStandards project (www.geogstandards.edu.au) revealed a framework of common and distinctive elements related to the teaching of Geography which were consistently demonstrated by the national participant group of experienced and accomplished Geography teachers (Hutchinson & Kriewaldt, 2010; Kriewaldt, 2010).

So, the question arises… What makes your Geography lesson geographical?

In the workshop, participants were invited to consider this question and share their responses as part of a small group and whole group discussion. Although there are nine Standards emerging from the GEOGStandards project, five of the Standards were focused on during the workshop: Knowing Geography and the geography curriculum; Fostering geographical inquiry and fieldwork; Developing geographical thinking and communication; Understanding Geography teaching – pedagogical practice; and Planning, assessing and reporting.

The theory-practice nexus suggests the following factors in the diagram below contribute to a geographical Geography lesson

Authors' photograph taken from the powerpoint slide of the authors' workshop at the GTA NSW & ACT Conference

Each factor can be connected to one or more of the GEOGStandards as well as the literature about geographical assessment, indicating that what becomes privileged in our pedagogy as a Geography teacher, should also become evident and valued in our Geography assessments. For example, as a Geography teacher, our lessons should be hinged upon an overarching inquiry question and we should be incorporating a range of geographical tools in to our lessons to help our students develop the skills of inquiry, interpretation of content, and its conceptual analysis, reasoning and application across a range of scales, perspectives and contexts. By modelling such factors in our teaching practice, the use of terminology and development of geographical literacy becomes inherent. Through a combination of immersion, moments of explicit instruction, and being encouraged to investigate, our students become Geographers and learn to both think and communicate in a geographically distinctive way. What is valued and known to be distinctively geographical in our teaching practice, should also be valued and evident in our assessment activities for the subject.

Returning to the thought provoker for personal reflection

Author's photographs and collage

Having considered the research and selected key messages from the workshop in the context of one of your Geography classes and a particular unit of work, have any of your responses to the following questions been challenged or confirmed?

1. What do I want my students to be able to know, do and understand ***that is distinctly geographical*** by the end of [insert timeframe for the program]?
2. How will I know when students have achieved this or are working towards its achievement?

3. How will the students know when they have achieved this or are working towards its achievement?
4. What makes my Geography lessons in this program *distinctly geographical*?
5. What makes the assessment activities in this program *distinctly geographical*?

In closing, you are invited to consider what your next steps will be to ensure your teaching practice in the Geography classroom and an upcoming Geography assessment becomes as distinctly geographical as possible.

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COMPETITIONS

Australian Team at the 2019 International Geography Olympiad in Hong Kong, China

Four Year 12 students will represent Australia at the XVI International Geography Olympiad to be held in Hong Kong, China, from Tuesday 30 July to Tuesday 6 August. The team was selected following their outstanding performance at last year's Geography's Big Week Out held on Kangaroo Island, South Australia. Representing Australia in Hong Kong will be:

Alex Shierlaw, St Peter's College, South Australia
Stefan Simic, McKinnon Secondary College, Victoria
Eleanor Smith, Kilvington Grammar School, Victoria
Jacob Thai, Sydney Grammar School, New South Wales

The International Geography Olympiad is an annual competition for the best 16 to 19-year-old geography students from around the world. The theme of the 2019 Olympiad is "Discovering a vibrant city for our smart future".

Australia's 2019 Olympiad team was chosen from sixteen high performing Year 11 students who participated in the 2018 Geography's Big Week Out – an intensive six-day residential programme with challenging geographical activities. Selection of Year 11 students to that event is based on their performance in the school round of the Australian Geography Competition.

The Australian Team at the 2020 International Geography Olympiad in Istanbul, Turkey, will be selected based on students' performance in this year's Australian Geography Competition, visit www.geographycompetition.org.au.

To find out more about the 2019 International Geography Olympiad in Hong Kong, China, visit www.eduhk.hk/igeo2019/.

Investigating human & natural environments at Sydney Olympic Park

Alexandria Lucas, GTA NSW & ACT Councillor

An afternoon at the Intertidal Wetlands of SOP, led by Danielle, a SOP education specialist

Sydney Olympic Park Authority

Delegates were fortunate to take part in several presentations and workshops presented by the Sydney Olympic Park Authority on day one of the GTA NSW & ACT conference. Delegates could elect short format presentations or a full day emersion program.

Sydney Olympic Park (SOP) focused their presentations around hands on learning, facilitating an opportunity for teachers to learn how to use various fieldwork equipment and complete a variety of activities. Not only were delegates given the chance to explore the fieldwork options available at SOP and learn more about the park itself, but also an explanation of how these fieldwork activities could be adapted to a fieldwork site near their own school. SOP were forthcoming with resources and provided some tips on how to adapt these resources for many different types of environments. They also gave some great tips on what fieldwork equipment a school could invest in to enhance their fieldwork program. Delegates provided positive feedback on the education programs provided by SOP and loved the opportunity to "get out of the classroom" and complete some hands-on learning!
A full list of the education programs available at SOP can be found at www.sydneyolympicpark.com.au/Education/School-Programs

Additional information

Teachers can prepare for fieldwork trips by utilising the downloadable Fact Sheets, available in the Education Resource Centre on the SOP site www.sydneyolympicpark.com.au/Education/Resource-Centre

The Geography Teachers' Association of NSW & ACT

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

AWARDS CEREMONY

ANZ Stadium, Sydney Olympic Park

GTA NSW & ACT Conference – Tuesday 2 April 2019

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

The Geography Teachers' Association of NSW & ACT – Awards Ceremony

The Geographical Fieldwork and Research Award – Stage 4 Category

First Place

Matea Miletic and Alanna Nahas

Year 8, Good Samaritan Catholic College
Teacher: Raquel Russo

The residential uses of water

Synopsis: This web-based project investigates the residential use of water in the suburbs of Middleton Grange and West Hoxton. These included personal uses, kitchen use, outdoor use and recreational uses. Data compared to the amount of water released to the postcode 2171 by Sydney Water. Finally, conclusion drawn in relation to the dominant use of water in the area, and the amount of water used on a particular day that the project was undertaken. The students used geospatial technologies to locate the areas and use the maps as part of the visual representation of the findings. The data analysis demonstrates a high standard of research and knowledge about the chosen sites and included reference to a variety of issues that challenge sustainable use of water.

Second Place

Amelia Moran

Year 7, SCEGGS Darlinghurst
Teacher: Katie Treacy

Liveability of Clovelly

Synopsis: In this report, Amelia conducted primary research and used geospatial technology to complete the task. She has investigated by using a survey of local residents then very creatively offered suggestions on how to improve the liveability of the suburb based on her survey findings. The final report is geographically detailed and succinct. There is clear evidence of both primary and secondary research to evaluate the findings. Excellent use of geographic tools to express the liveability of Clovelly. Skilfully constructed graphs and the representation of data.

Third Place

Leyla Ozen

Year 7, SCEGGS Darlinghurst
Teacher: Katie Treacy

Liveability of Hunters Hill

Synopsis: Leyla has effectively used geospatial technologies, as well as primary and secondary research to investigate the liveability of Hunters Hill. She incorporates graphs and a wide variety of images to demonstrate a clear understanding of the topic. The report supports and draws upon her investigation and included survey findings, interview transcript and graphical representation of data to highlight her research. Strongly concluded and evidenced.

Equal Fourth Place

Henry Good

Year 8, Wollondilly Anglican College
Teacher: Trudy Miller

The liveability of Mittagong

Synopsis: Henry has utilised geospatial technology, primary research in the form of surveys and secondary sources to investigate the liveability of Mittagong. The report showed a strong understanding of issues surrounding liveability and the criteria on which we consider how liveable places are. The justification and liveability rating were well constructed and supported. Impressive use of small and large- scale maps.

Jessica Millin

Year 7, SCEGGS Darlinghurst
Teacher: Katie Treacy

Investigating the liveability of Northbridge

Synopsis: Jessica's report on the liveability of Northbridge shows detail and geographic information that she gathered during fieldwork. She was able to use surveys to inform her opinions about liveability. Jessica skilfully created graphs that represented the finds of her survey. Well annotated photographs that highlight the criteria of liveability.

The Geographical Fieldwork and Research Award – Stage 5 Category

First Place

Dorina Wu

Year 10, Tara Anglican School for Girls
Teacher: Rebecca Wood

Impact of housing and recreational areas on the pH of soil compared to natural forest areas

Synopsis: Dorina has written an excellent geographic report that clearly describes the impacts of houses on the soil in Cumberland State forest. Soil testing was a highlight of the report and the results showed a deep understanding of the impacts of the proximity of housing. The digital photographs enhanced the report as they provided a visual representation of the site and the relationships with the findings. Suggestions for solutions show a practical response to the issue. Detailed maps and annotated photographs used to show the extent of the impacts of housing.

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

The Geography Teachers' Association of NSW & ACT – Awards Ceremony

Second Place

Isabella Grigson

Year 10, Tara Anglican School for Girls

Teacher: Melissa Losco

Cumberland State Forest

Synopsis: This extensive geographic report demonstrates strong knowledge and understanding about the Cumberland State Forest and the human impacts. Clearly applies a variety of primary research methods and is carefully planned and detailed. Highlights of the report include the surveys using a large sample, photos and fieldwork to investigate the nature of the impacts in the forest region. Secondary sources used to supplement primary research. The research findings presented in an engaging and sophisticated way. The report also proposes effective solutions to the environmental issues.

The Geographical Fieldwork and Research Award – Stage 6 Category

First Place

Dimitri Efstalhiadis

Year 12, Canberra Grammar School

Teacher: James Cameron

An investigation of the Thredbo River

Synopsis: An outstanding geographical IBDP report based on theoretical and practical research. James investigated how the change in altitude downstream of the Thredbo River influenced velocity, discharge and wetted perimeter. The use of the Bradshaw Model to explain the expected physical and fluvial changes was the basis for his findings. Transects described the changes in altitude and Google Earth was used to measure distances to increase accuracy. Scatter graphs showed the correlation of his data and provided an instant visual representation. Conclusion strongly supported the use of the Bradshaw model.

The Dr Don Biddle Places and Environments Study Award

First Place

Lilly Dougherty

Year 10, Hunter School of Performing Arts

Teacher: Roslyn Murton

The impacts of the Newcastle light rail construction

Synopsis: Excellent research project that uses four different primary methodologies including, interviews, questionaries, digital photographs, and a focus group to inform her knowledge about the aims and hypothesis. Clearly set out and detailed geographic findings that show environmental, economic and social impacts of the changes due to the light rail construction. The visual representation of data in graphs was both accurate and reliable based on the primary research conducted. A key highlight was the community forums where Lilly discussed questions that enabled her to see a variety of perspectives about the competing needs of construction in response to population growth.

Second Place

Moana Faasisila

Year 10, Hunter School of Performing Arts

Teacher: Ben Carle

Newcastle Buses – Driving Change

Synopsis: Moana has very diligently used her own experience as a student that relies upon public transport to inform her work. She also conducted interviews with other people to see how the 2018 changes to the public buses affected them. The majority finding that it increased their journey. She asked questions about the new bus routes and the inconvenience the privatisation of buses has had. Her focus questions explored how access to buses changed has, what were public perceptions, why privatisation was important and what are the opinions of bus personnel.

Her impressive self-evaluation highlights the importance of a voice when issues affect people and the gratitude in having the opportunity to explore this topic as part of her studies in Geography.

Third Place

Ella Hall-Ainscough

Year 10, Hunter School of Performing Arts

Teacher: Ben Carle

Rejuvenating Off-Leash Dog Parks in Newcastle

Synopsis: Ella geographical research project explored the issues surrounding unsafe dog parks in Newcastle. She cleverly compared three dog parks in the analysis using both primary and secondary research. Excellent use of large and small-scale maps and strong reliable methodology to collect data. The detailed photographs that she took supported her findings and evidenced her concerns. Ella highlighted the difficulty in conducting surveys as a form of data collection and the impact of bias. Great video link that showed her research findings. Variety of recommendations and annotated bibliography.

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

The Geography Teachers' Association of NSW & ACT – Awards Ceremony

The Brock Rowe Senior Geography Fieldwork Award

First Place

Nicholas Wilson

Year 11, Merewether High School

Teacher: Rachael Tonks

Green Space and Tree Removal in Cooks Hill and Newcastle

Synopsis A highly sophisticated SGP, which was clearly set out with focus on the aims and methodology to collect the data, needed to complete the research. Thorough in its use of primary and secondary data to explore and analyse the research topic in a logical and linear manner. A clearly exemplary SGP that used spatial technology including maps and satellite photographs to show the extent of the removal of trees. Photographs proved very valuable, as he was able see the changeover time. Nicholas wrote about the importance and benefits of urban forests and the tangible benefits including the reduction in temperature. Public opinion clearly divided as shown in the survey results compiled between the aesthetes of the trees and the impacts on surrounding public amenities.

Second Place

Joselyn Singh

Year 11, Tara Anglican School for Girls

Teacher: Heather Liney

Biodiversity of marine organisms Maria Island Tasmania

Synopsis: As part of the University Connections Program [Institute of Marine Antarctic Science] Joselyn was one of 15 fortunate interstate students chosen to attend, the unique environment on Maria Island, clearly this inspired her SGP. Her aim was to assess whether the Marine Reserve within Maria Island National Park influences biodiversity. Her objectives included an investigation of the biodiversity of temperate zooplankton communities within two sites of the Maria Island Marine Reserve. The methods to collect her data included snorkeling sampling transect ally underwater and visual underwater fish census. Joselyn's evaluation of her SGP demonstrates that she fully immersed herself in her study and through her experience was able to gather scientific techniques that have geographic applications.

Equal Third Place

Ethan Behrens

Year 11, Warners Bay High School

Teacher: Rachel Noonan

Water Quality in Lake Macquarie

Synopsis: An investigation into the water quality in Lake Macquarie that explores the historic and current water quality. Another aim of the SGP was to determine the impact of various strategies implemented over time. Ethan used literature reviews as secondary sources and collected primary evidence including water testing. From the data that he collected he was also able to determine that visitation to the Lake had declined due to poor water quality. Graphs and data used to represent the findings.

Zoe Lindhout

Year 11, MLC School

Teacher: David Latimer

Water Quality in Rozelle

Synopsis: Zoe's Senior Geography project focused heavily on the urban water quality in Roselle and its management. She also explored the extent to which estuarine vegetation affects water quality and how to mitigate the threats then further evaluated the council responses in protecting the water quality. Primary methods of gathering data included water quality testing of the p H levels, nitrates, and turbidity. Local residents provided valuable information about the change overtime and provided important perspectives on the issue.

Equal Fourth Place

Tahnee Marriott

Year 11, Warners Bay High School

Teacher: Rachel Noonan

Warners Bay Development Project

Synopsis: The aims of this SGP included an investigation of the development plans for Warners Bay. Further how the development will affect local residents. Tahnee used various primary methods to collect data including an interview with local council to discover the aims of the upgrade. The use of documents such as Plans of Management from the council greatly assisted her research as they gave her an authentic source on which to base her findings. Her self-evaluation showed that she had gained geographical knowledge and improved her perspective on this matter.

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

The Geography Teachers' Association of NSW & ACT – Awards Ceremony

Vishaal Varma

Year 11, Canberra Grammar School

Teacher: James Cameron

Thredbo River Investigation

Synopsis: This report is part of the Fresh Water – Issues and Conflicts Option in the International Baccalaureate Geography Course. A clearly written and investigated project that uses reliable methods of investigation including the use of a flow meter at various sites to compare the velocity of the water at different heights. Vishaal was able to demonstrate why meanders form and develop over time. Use of photographs and graphs added a level of sophistication to this report.

Highly Commended

Daniel Ambler

Year11, The Hills Grammar School

Teacher: Helen Laidler

An investigation into the socio economic and environmental implications associated with land clearing in the Hills Shire

Synopsis: Urban growth in the Hills area has grown exponentially in the last 10 years and has resulted in many issues including land clearing. Daniel was able to use statistics from the ABS to determine the population growth in the Hills Shire. From this, he then drew out the implications of land learning for housing and infrastructure in the area. Part of the study included sustainable management of this growth in the future. An extensive appendix of secondary sources clearly informed Daniel and guided his SGP.

The Dr Susan Bliss Cross-Curricular Priority Awards

First Place

Alisha Gugnai and Jet Hall

Year 7, Tara Anglican School for Girls

Teacher: Rebecca Wood

Lake Parramatta

Cross Curricular Priority – Aboriginal and Torres Strait Islander Histories and Cultures

Synopsis: The students were able to explore the spiritual values and significance of Lake Parramatta to the local Indigenous groups. Through fieldwork the history, culture and the ongoing impact of the ATSI knowledge and understanding presented in a creative way. A key theme of the project was the importance of sustainability and the future protection of the Lake.

Second Place

Emily Prickett

Year 11, Newcastle Grammar School

Teacher: Drew Collins

Food Waste

Cross Curricular Priority – Sustainability

Synopsis: Emily investigated the disposal of food waste in range of Newcastle based companies and explored their involvement in waste management strategies such as Oz Harvest. Primary research conducted included an interview with the Oz Harvest Newcastle manager and surveys of food waste practices. Her message is clear 40% of food is disposed of before it gets to super markets due to odd appearances and imperfections so buy the "odd bunch" in supermarkets such as Woolworths and reduce food waste!

The Dr Maurine Goldston-Morris Civic and Citizenship Award

Equal First Place

Sophie Carstens

Year 7, Hunter Valley Grammar School

Teacher: Alexandria Lucas

The Value of Water

Civil Action: Creating a storybook about the use of water for young children.

Synopsis: An excellent storybook that is very engaging and age appropriate. Sophie has used a water theme to enhance and promote the safe use of water and the importance of a sustainable future. The storybook also raises awareness about the global shortage of water resources. Her book took us on a journey through various countries as well as sites and educates its readers about the importance of water.

Sarah Van Vreumingen

Year 10, Cedars Christian College

Teacher: Linda Vanderschoor

Coastal Management Report

Civil Action: Wrote a letter to Local Council highlighting coastal issues.

Synopsis: Sarah completed her report on coastal management along Coniston Beach in Wollongong. By writing a letter to the local council, she hoped that raising awareness of the coastal erosion and deposition would lead to better land management and encourage people to join in.

2018 ARTHUR PHILLIP FIELDWORK COMPETITION

The Geography Teachers' Association of NSW & ACT – Awards Ceremony

The Dr Maurine Goldston-Morris Teacher Award

Rachael Tonks

Merewether High School

Rachael has inspired her students to a high level of geographical understanding through research in the field and through secondary sources. Her students have discovered about Geography through the studies of a wide variety of issues employing a variety of ICT methodologies. Rachael's students indicate that geographic literacy is a priority. Rachael is commended on the quality of her students' research and breadth of presentations of topics. She has consistently inspired her students to learn about the ever-changing world.

GTA NSW & ACT would like to congratulate all the winners and also commend the students and teachers who have participated in this competition.

About the Competition

The Geography Teachers' Association of NSW & ACT organises this annual competition for students and schools to foster an enthusiasm for Geography through engagement and rewards. The emphasis of the competition is fieldwork and the gathering of primary data as part of authentic research in Geography.

In 2018, the submission of entries and the prize categories were updated to better reflect the requirements of the new Australian K–10 Geography Curriculum and the central place that inquiry holds within Geography. The award categories have been modified to reflect the Australian K–10 Geography content now used in both NSW and ACT.

Teachers are encouraged to use the competition as a form of authentic assessment for their teaching and learning programmes. The competition is open to all primary and secondary schools in NSW and ACT. Entries are welcome from both members and non-members of GTA NSW & ACT.

About the Geographers

Admiral Arthur Phillip (1738–1814) joined the Royal Navy at fifteen and worked his way up the ranks to be appointed captain of HMS Sirius in 1786. Phillip was appointed Governor of New South Wales, the first British colony on the Australian continent. He was also the founder of the city of Sydney. As an experienced sea captain he had an excellent knowledge of the geography of the world.

Dr Don Biddle OAM was the President of GTA NSW from 1963 –1970 and Fellow of the Association. He received an AM for his service to education and the field of Geography through the development of curriculum and his contribution to professional bodies.

In honour of his role in Geography over many years, the Issues in Australian Environments award carries his name. This category is an opportunity for students undertaking their junior geography project in Years 9 and 10.

Brock Rowe was a founder of GTA NSW and he became a Fellow of the association in 1982. In honour of his role in the association and his contribution to Geography over many years, the original fieldwork competition for individual senior geography projects was given his name.

Dr Susan Bliss joined GTANSW in 1961 as a student at Sydney University and became a GTANSW Councillor in 1981, giving continuous service until her retirement in 2013.
Award entries demonstrate significant achievement or development of understanding in any of the three Australian K–10 Geography Curriculum cross curricular priority areas; Aboriginal and Torres Strait Islander histories and cultures, Asia and Australia's engagement with Asia or Sustainability.

Dr Maurine Goldston-Morris OAM devoted herself to the life and achievements of Arthur Phillip, she was President of the Arthur Phillip Society.

Two awards for Civics and Citizenship and for Geography teachers honour her achievements.

2018 ARTHUR PHILLIP AWARD RECIPIENTS

ADVICE TO CONTRIBUTORS

Geography Bulletin guidelines

1. ***Objective:*** The Geography Bulletin is the quarterly journal of the New South Wales Geography Teachers' Association, Inc. The role of the Geography Bulletin is to disseminate up-to-date geographical information and to widen access to new geographic teaching ideas, methods and content. Articles of interest to teachers and students of geography in both secondary and tertiary institutions are invited, and contributions of factually correct, informed analyses, and case studies suitable for use in secondary schools are particularly welcomed.

2. ***Content:*** Articles, not normally exceeding 5000 words, should be submitted to the GTA Office by email gta.admin@ptc.nsw.edu.au

   Submissions can also be sent directly to the editors: Lorraine Chaffer (lchaffer@tpg.com.au)

   Articles are welcomed from tertiary and secondary teachers, students, business and government representatives. Articles may also be solicited from time to time. Articles submitted will be evaluated according to their ability to meet the objectives outlined above.

3. ***Format:*** Digital submission in Word format.

- Tables should be on separate pages, one per page, and figures should be clearly drawn, one per page, in black on opaque coloured background, suitable for reproduction.
- Photographs should be in high resolution digital format. An indication should be given in the text of approximate location of tables, figures and photographs.
- Every illustration needs a caption.
- Photographs, tables and illustrations sourced from the internet must acknowledge the source and have a URL link to the original context.

Note: Please try to limit the number of images per page to facilitate ease of reproduction by teachers.

Diagrams created using templates should be saved as an image for ease of incorporation into the bulletin.

All assessment or skills tasks should have an introduction explaining links to syllabus content and outcomes. A Marking Guideline for this type of article is encouraged.

4. ***Title:*** The title should be short, yet clear and descriptive. The author's name should appear in full, together with a full title of position held and location of employment.

5. ***Covering Letter:*** As email with submitted articles. If the manuscript has been submitted to another journal, this should be stated clearly.

6. ***Photo of Contributor:*** Contributors may enclose a passport-type photograph and a brief biographical statement as part of their article.

7. ***References:*** References should follow the conventional author-date format:

   Abbott, B. K. (1980) ***The Historical and Geographical Development of Muswellbrook*** Newcastle: Hunter Valley Press.

   Harrison, T. L. (1973a) ***Railway to Jugiong*** Adelaide: The Rosebud Press. ***(2nd Ed.)***

Refereeing

All suitable manuscripts submitted to the Geography Bulletin are subject to the process of review. The authors and contributors alone are responsible for the opinions expressed in their articles and while reasonable checks are made to ensure the accuracy of all statements, neither the editor nor the Geography Teachers' Association of New South Wales Inc accepts responsibility for statements or opinions expressed herein.

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