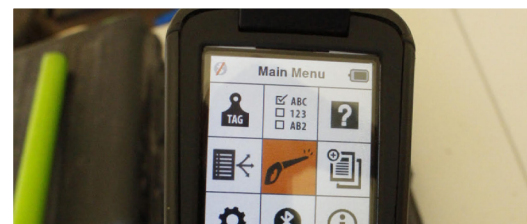Agriculture in Education:
an educational resource for Year 9-10 Design and Technologies

Precision Sheep Management

AGRIFOOD
SKILLS AUSTRALIA

Precision Sheep Management
Year 9-10 Design and Technologies

Investigate and make judgments on the ethical and sustainable production and marketing of food and fibre	*ACTDEK044*
Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication	*ACTDEP049*
Evaluate design ideas, processes and solutions against comprehensive criteria for success recognising the need for sustainability	*ACTDEP051*

Source: Australian Curriculum v8.1
http://www.australiancurriculum.edu.au/technologies/design-and-technologies/curriculum/f-10?layout=1 - level9-10

Learning Outcomes

At the end of this unit of work, students will be able to:

- Demonstrate an appreciation of the nature and importance of Australia's sheep industry;

- Appreciate the role of research in assisting sheep farmers become more efficient and sustainable producers of food and fibre;

- Describe technologies for monitoring and assessing sheep health and welfare;

- Explain how sheep farmers are adapting management practices within their livestock production systems;

- Analyse and draw informed conclusions from raw data sets of sheep monitoring;

- Make informed judgments on the sustainability and productivity of sheep production and management systems; and

- Develop, communicate and evaluate a designed solution for a sheep production system.

Description

This resource enables students to gain an insight into technologies that are enhancing Australia's capability and efficiency as a sustainable producer of food and fibre - in this instance sheep for both meat and wool. It provides students, working within the food and fibre technologies context, with the necessary background knowledge to undertake the major assessment task, which is to plan and produce a designed solution for assisting sheep farmers manage their production systems more efficiently and increase their productivity as meat and wool providers.

It is supported by the accompanying video - _Precision Sheep Management_ (_https://youtu.be/HbuKe0IjsbQ_).

This resource has applications for teachers integrating STEM within students' food and fibre technologies specialisation.   It provides Maths teachers with a practical context from which students can analyse raw data being collected under the **Enhanced sheep wellbeing and productivity** research program at the University of New England. The data, in an excel spreadsheet, contains 11 entries for a sample of 150 sheep. Students draw conclusions from the data using pivot charts and use this as an authentic context for developing a designed solution for livestock production.

Student Activity 1: The role of research - What do you think?

Student Activity 2: Australian Sheep Industry - web search Parts 1 and 2

Student Activity 3: Enhancing sheep well-being and productivity Parts 1 and 2

Student Activity 4: Data analysis in precision sheep farming Parts 1 and 2

Assessment:

Background Notes for Teachers – Australian Sheep Industry

'Resilient, profitable and competitive agricultural and rural industries need to actively consider what is coming and be well placed to respond'[1].

Historical Overview: The raising of sheep for meat and wool is one of Australia's oldest and most successful agricultural industries and one of its most iconic.

From the 1840s to the 1950s, the Australian economy was regarded as 'riding on the sheep's back' and agriculture, especially wool, played a key role in Australia's development as we became a leading exporter of fine food, meats and grains.

Farming methods have changed considerably over the past 200 years. Farmers have coped with climatic variations, floods and drought and the need to improve and conserve soil. They have managed the consequences of over clearing, over grazing and feral animals. They have also dealt with remoteness and long distances to source supplies and equipment and to transport produce to market. In doing so, Australian farmers have demonstrated their adaptability, resilience and inventive capabilities.

Wool: While agricultural production has diversified, Australia is still a dominant producer and exporter of wool and today, producing around 25 per cent of the greasy wool sold on the world market. The value of Australian wool exports in 2015-16 is estimated at around $3 billion, owing to strong global demand for Australia's wool, which is regarded as among the world's best.

Wool is produced in all Australian states except the Northern Territory. NSW produces the greatest volume, followed by Victoria, Western Australia and South Australia. In 2014-15, over 70 million sheep were shorn in Australia.[2]

Sheep Meat: The production of sheep meat – lamb and mutton, is now the real growth opportunity for Australian sheep farmers. Lamb can be produced in a wide range of climates – from arid and semi-arid inland areas to the high rainfall areas of NSW, Victoria, South Australia, Tasmania and Southwest Western Australia.

There are three major groups of sheep breeds in Australia:

• those producing wool;

• those bred for meat; and

• dual-purpose sheep grown for their wool and meat.

Merinos and their crosses are the main sheep breed. While merinos produce fine wool, they also play a vital role in meat production. Meat from merinos is highly sought after by Middle Eastern countries, while Australian consumers and the U.S market, prefer the larger lean lambs produced from Merinos crossed with meat and dual purpose breeds (mostly British types). *Meat & Livestock Australia Sheep Breeds* (*http://www.australian-meat.com/uploadedImages/ Foodservice/Proteins/Lamb/Lamb_Grid.jpg*)

It is projected that the Australia sheep industry will continue to transition from a merino focused industry to one concentrating more on producing prime lambs.[3]

Since 2000, Australia's agricultural workforce has declined from over 432,000 to just 321,000 today, but 1.6m people work in the "farm dependent economy." These 1.6m people represent 17.2% of the total Australian workforce).

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1   Industry Futures: Megatrends impacting Australia's agriculture over the coming twenty years. RIRDC
    https://rirdc.infoservices.com.au/items/15-065

2   Australian Government. Department of Agriculture and Water Resources
    http://www.agriculture.gov.au/ag-farm-food/meat-wool-dairy/wool - importingexporting--wool

3   Meat & Livestock Australia – Australian Sheep Industry Projections 2015
    http://www.mla.com.au/prices-markets/trends-analysis/sheep-projections

Background Notes for Teachers – Australian Sheep Industry (cont)

"*As workforce numbers have decreased, labour productivity has increased - essential to maintain and grow industry output. 'Labour productivity' is the industry output divided by the number of workers and is a measure of the efficiency with which workers convert raw inputs into the final consumable products of a particular industry (food and fibre in the case of agriculture). Productivity improves over time due to innovation and to the discovery of new ways to make more product with the same or fewer inputs*".[4]

Australia's Rural Industries Research and Development Corporation (RIRDC) has identified five factors (megatrends) that will impact on our rural industries over the next 20 years.

1. A hungrier world: Population growth will drive global demand for food and fibre.

2. A wealthier world: A new middle class will increase food consumption, diversify diets and eat more protein.

3. Choosy Customers: Informed consumers with increased expectations for health, sustainability and ethics.

4. Transformative Technologies: Advances in digital technology, genetic science and synthetics will change the way food and fibre products are made and transported.

5. A bumpier ride: Globalisation, climate change and environmental change will reshape the risk profile for agriculture.

'*By providing food for just over 130 million people, Australia supports a population over five times larger than its own. However, in the context of a regional Asian population of approximately 4.5 billion, Australia is a long way off being a 'food bowl' to Asia. It will likely never be.*

Ultimately Australia could feed more people than it does today. However, the methods to achieve this appear to lie in achieving greater input efficiency and technology adoption, rather than drastically shifting production or eating less meat.' [5]

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4 Rural Industries Research and Development Corporation (RIRDC) - Rural Industries Futures
https://rirdc.infoservices.com.au/items/15-092

5 Deloitte Australia – 'Food bowl' Rhetoric or reality - Part 2: Can we feed more people? AgriBusiness Bulletin
http://www2.deloitte.com/au/en/pages/consumer-business/articles/food-bowl-rhetoric-reality-part-2-can-australia-be-food-bowl.html

discuss

Setting the Scene

The following activities and web links provide a contextual basis from which students gain an appreciation of the Australian sheep industry's sustainability, profitability and competitiveness. The background information:

- Overviews the nature and importance of the sheep industry;

- Highlights the industry's contribution to the Australian economy and its position in world markets for wool and sheep meat;

- Identifies industry and research priorities for Australian agriculture;

- Draws student attention to some of the many industry organisations, grower groups and professional services firms working across the sheep value chain; and

- Facilitates student access to a range of secondary sources that profile industry priorities, research initiatives and technological advances.

Students are invited to access two key agricultural research institutions within Australia, where they are introduced to examples of sheep industry related research. This is designed to show students where they can source background context for their assessable design solution.

At this stage, teachers need to advise students that they will be required to design a technology solution for assisting sheep farmers manage their livestock production systems more efficiently and sustainably. This is their major assessable task. The following activities are designed to assist students develop their understanding of the sheep industry and will direct them to examples of how sheep and wool farmers are incorporating technological innovations into their livestock management systems. Students are also provided with a real life context in which to apply and interpret data to manage a hypothetical scenario.

It is suggested that teachers introduce this learning activity by asking students to read the background information in Resource Sheet 1 and by generating discussion around the quote in Student Activity 1.

Print and distribute:

- The Australian Sheep Industry: Resource sheet 1 - Background information

- Student Activity 1: The Role of Research - what do you think?

- Student Activity 2: Australian Sheep Industry - web research Parts a) and b)

The quotes are from institutions of interest to students within the Food and Fibre technologies specialisation. Australia's food and fibre industries are served by many industry associations, research institutions, grower groups and professional services firms. Together they provide a valuable source of information, being as they are, the mouthpiece of Australia's agricultural industries.

Once students have some familiarity with these organisations and the range of online information they provide, students will be able to draw on them for their individual research as they progress through this unit and design their technology solution.

The Australian Sheep Industry

Resource sheet 1

Background Information

Read the following information carefully. It provides you with a base from which to develop your understanding of why sheep production in Australia is so important.

Australian agriculture plays a vital role in supplying the growing global food and fibre markets.

Producing sheep for meat:

- The demand for food - especially protein, is growing rapidly in countries such as China and India. These are two of Australia's key trading partners.

- Australia can't possibly feed Asia, but we can share our agricultural knowledge and technological ability with these countries, to help them develop their agricultural production.

- World demand for sheepmeat – lamb and mutton, is growing. People want to eat lean and tender meat produced from healthy and well cared-for sheep.

- Australia is regarded as a safe, reliable and high-quality supplier of lamb and mutton.

- About 50% of Australia's production of sheepmeat is consumed locally.

- The remainder is exported to countries such as the United States, China, the United Arab Emirates and Saudi Arabia.

Producing sheep for wool:

- Australian merino wool is regarded as the world's best quality woollen fibre.

- Australian woolgrowers have a reputation for being reliable wool producers.

- Our sheep farmers are experienced in selecting their best animals for breeding purposes. This enables them to produce clean, fine wool of high strength within the various climates and environments that wool is produced in across Australia.

- Two of Australia's most important overseas customers are the high-fashion European market and the growing Chinese market.

Access this link to find out the various sheep breeds. You may need to refer back to this.
Meat & Livestock Australia Sheep Breeds
http://www.australian-meat.com/uploadedImages/Foodservice/Proteins/Lamb/Lamb_Grid.jpg

Key Issue:

Australian researchers are continually looking for ways to help our sheep farmers become more efficient and sustainable producers of food and fibre.

task

Student Activity 1: The role of research - what do you think?

Rural industries may be defined as 'a collection of farm businesses and their employees, using plant and animal production systems to create food and fibre products for human consumption. Australian and New Zealand Standard Industrial Classification [1].

- Discuss with your teacher your understanding of a farm business and plant and animal production systems.

- Are these on-farm activities, related off-farm activities or both? Give your reasons.

The statement below is taken from a recent report predicting the future of our agricultural production and management systems.

Read and discuss the following:

> *'Australia's rural industries will be impacted by significant change at global, national and local levels over the coming decades. This will create opportunities and challenges for small and large farm businesses. It will have an impact on rural lifestyles, agricultural landscapes and Australia's society and economy in general'.*
>
> *Industry Futures: Megatrends impacting Australia's agriculture over the coming twenty years. . Rural Industries Research & Development Corporation (RIRDC) - http://www.rirdc.gov.au/*

The following investigations can be shared between the class.

Group 1: Access the RIRDC website at *http://www.rirdc.gov.au/about-rirdc*

1. What is the role of Rural Industries Research & Development Corporation (RIRDC)?

2. Find some areas of research being undertaken by RIRDC. Share these.

Group 2: Access the CSIRO Website at *http://www.csiro.au/en/Research*

3. What is the role of the CSIRO? What is the full name of this organisation?

4. Find some examples of research into the livestock industry. Share these.

As a class:

5. Suggest why these research organisations are important. Who funds them?

6. Suggest how the community can be affected by the skills and efficiency of Australia's sheep farmers?

7. Identify some opportunities and challenges that may lie ahead for Australia's rural industries.

task

Student Activity 2: Australian Sheep Industry - web research Part 1

This is a shared class research task with students in small groups. All five websites below need to be accessed by at least one group. In most cases, students research one website only. However, students in smaller classes could be encouraged to access more than one.

A great deal of information about the Australian sheep industry is available online. The following key facts are an example. Record these and their source, for your own use.

Key facts:

- Wool is Australia's 3rd largest agricultural commodity export after beef and wheat.

- Lamb is Australia's 6th largest agricultural commodity export after barley and wine.

- Estimated value of wool exports in 2015-16 - $3.14b.*

- Estimated value of lamb exports in 2015-16 - $1.68b.*

   Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

As part of the class research team, your group is tasked with finding, collating and sharing the information requested below. Each website presents a different focus.

Once allocated a website:

1. Record the organisation and website.

2. Investigate the suggested aspects for your chosen organisation.

3. Think up a suitable heading that summarises what you have researched.

4. Synthesise your findings into one group set of concise points to share with your class.

5. Decide as a group, who the information on this website might be written for.

Meat & Livestock Australia (MLA)

http://www.mla.com.au/Prices-markets/Trends-analysis/Fast-Facts

- How does Australia rank as a world producer and exporter of lamb, mutton and live sheep?

- Which three Australian states have the greatest number of sheep?

- Which state produces the most sheepmeat? Suggest why this is.

- What are Australia's three largest export markets for mutton, lamb and live sheep?

- How much Australian lamb do we consume per person per year in Australia? How does this compare with other countries?

Australian Wool Innovation Limited (AWI)

http://www.wool.com/

- Provide some examples of on-farm research and development funded by AWI.

- What is the purpose of AWI's research into alternative wool harvesting technology?

- How does the ShearEzy shearing system make the shearer's work easier?

- What are the six characteristics used to price wool?

- Access AWI's online magazine - Beyond the Bale. What is its purpose?

task

Student Activity 2: Australian Sheep Industry - web research Part 2

Department of Agriculture and Water Resources
http://www.agriculture.gov.au/ag-farm-food

- Search Agriculture, farming and food – which state is the largest wool exporter?

- Which state exports the most lamb? Which one exports the most mutton?

- Name the three largest overseas customers for Australian mutton.

- The wool levy – what is it used for and who pays it?

- What are RDCs? How can they help farmers?

Australian-meat.com Meat & Livestock Australia (MLA)
http://www.australian-meat.com/Foodservice/Proteins/Lamb/Why_Australian_Lamb_/

- List the six defining qualities of the marketing term - *Australian Lamb*.

- What are the nine basic cuts of Australian lamb?

- Why is it important for lamb to be packaged correctly?

- Why are meat safety and animal welfare so important?

- Find examples of how the Australian livestock industry is contributing to sustainability.

Beef and Lamb Consumer website - Meat & Livestock Australia (MLA)
http://www.beefandlamb.com.au/Home

- Hints for by buying and storing read meat.

- Essential nutrients in red meat.

- Nutrients and health - family focus.

- What is Meat Standards Australia? How does it work?

- If you were a chef, what would you do differently after seeing this website?

Follow up class discussion:

- What are the common themes?

- Sheep welfare and meat safety are important issues. Explain why these issues are important for:
  - Sheep farmers
  - You the consumer
  - The Australian Health System
  - The Australian economy
  - Our overseas customers
  - Animal welfare groups

- Reflect on the benefits of these websites and online services to sheep and wool producers and also to potential domestic and overseas customers.   What differences could you detect in how the information was presented for various target audiences?

- There has been much discussion in Australia about live sheep exports. Why do some countries prefer to import live sheep rather than buying the slaughtered and processed meat product?

Australia's primary industries (of which sheep is one) have a strong tradition of being innovative and adaptive to new challenges. Having participated in this discussion, you now have some background understanding that will help you start to plan the technology solution you will be designing for your assessment task.

Enhancing sheep well-being and productivity project

Teacher Background Notes

Australian agriculture plays vital role in supplying world food markets and in improving food security. Australia is well placed to increase its exports into expanding global food and fibre markets and to export agricultural expertise and know-how to emerging economies as they seek to develop their own agricultural sectors.

Current Situation:

- Rising wealth is impacting on commodity markets. Globally, more people are moving out of subsistence production and becoming more reliant on buying food. Diets are shifting from a reliance on staple foods (rice and grains) to high-protein foods such as dairy, fish, meat and eggs.

- Australian rural industries are growing their market share by communicating the quality and sustainability of their crop and livestock products.

- Advances in technology within the fields of digital, genetics and materials science are changing the way food and fibre products are created and transported.

- Genetic technology will allow crop and pasture yields to improve and become more resistant to weeds, pests and climate risks.

- Advanced sensory systems and data analytics are enabling advanced and highly integrated farm-to-fork supply chains.

- Customers are increasingly able to trace food and fibre products from their origins, and supermarkets will have increased tools for quality assurance.

There are Risks:

- Climatic variation and the increased frequency and severity of severe weather events.

- Interruptions to the increasingly globalised agricultural supply chain.

- Reduced effectiveness of herbicides and pesticides as weed and pest resistance grows.

- Increased biosecurity risk from the greater movement of people and goods across national borders.

Australian agriculture has previously adapted and responded to risks. Our ability to overcome these challenges in the future, will be driven by innovative technologies and enhanced knowledge.

discuss

Enhancing sheep well-being and productivity project

Teacher Preparation – Setting the Scene

This research project being conducted by the Sheep CRC, involves the development of methods for farmers to make accurate assessments of the condition and productivity of individual sheep at any one time. This enables them to make more informed management decisions.

Students can work collaboratively or independently on the following activities.

The Sheep CRC[6] is one of a number of cooperative research initiatives between the Australian Government and industry. The Sheep CRC is located at the University of New England in Armidale and 40 organisations across the sheep supply chain, are working with the Sheep CRC on various projects researching challenges to the Australian sheep industry.

In the following video, members of the research team demonstrate technologies that are enabling assessments of individual sheep to be made and explain what farmers are able to do with the data collected. They have also provided examples of the raw data that can be collected for students to work with in Activity 4.

Currently, the average annual mortality rate of adult sheep on Australian sheep properties is around 4%. Farmers know that poor nutrition, parasite infection, pregnancy and lambing, contribute to the risk of death. These risks have always been difficult to monitor and manage in a large flock, as the condition of one sheep can vary significantly from another.

Before watching the accompanying video - *Precision Sheep Management* (*https://youtu.be/HbuKe0IjsbQ*) ask students to suggest why managing sheep on an individual basis is a difficult and not always successful task. What risks do sheep face?

After watching the video, ask students to recall the technologies used and their purpose. Encourage students to undertake their own additional research to investigate how farmers are using the technologies and how they are delivering health, welfare and productivity benefits.

The website below is a useful follow-up resource for students as a means of furthering the understanding of sheep management issues and priorities.

Sheep Innovation CRC *http://www.sheepcrc.org.au/*

- Publications on meat and wool
- Precision sheep management (PSM)
- Practical Wisdom notes

Teachers may choose to give students copies of the assessment task and to offer guidance, at this stage, on their chosen design solution.

Print and distribute copies of all three sheets for Student Activity 3.

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6   Cooperative Research Centre for Sheep Industry Innovation
     http://www.sheepcrc.org.au/information/about-the-sheep-crc.php

Student Activity 3: Enhancing sheep well-being and productivity project

Background information for students

Australian agriculture plays a vital role in supplying the expanding global food and fibre markets and in improving food security. The demand for food, especially protein, from key trading partners such as China and India, is growing rapidly.

Australia has the knowledge and technological ability to increase world production and export, along with the capability to export expertise and know-how to emerging economies as they also develop their agricultural sectors.

Currently, the average annual mortality rate of adult sheep on Australian sheep properties is around 4%. Farmers know that poor nutrition, parasite infection, pregnancy and lambing, contribute to the risk of death. These risks have always been difficult to monitor and manage in a large flock, as the condition of one sheep can vary significantly from another.

The **Enhancing sheep well-being and productivity project** is researching and developing methods for farmers to assess the condition and productivity of individual sheep at any one time. This research is being conducted by the Cooperative Research Centre for Sheep Innovation (Sheep CRC)[7] located at the University of New England.

The supporting video *Precision Sheep Management (https://youtu.be/HbuKe0IjsbQ)* was filmed at the Kirby Research Station at the University of New England, Armidale NSW. Members of the CRC Sheep research team demonstrate and explain the technologies that are enabling accurate assessments of sheep to be made and what farmers are able to do with the data collected. .

The video explains how Australian sheep farmers are using available technologies to improve their management and production systems to meet growing local consumer demands and expectations, plus those from major export partners.

It shows how data on sheep body condition, weight change, genetic background and previous production history is obtained, using:

•   Radio Frequency Identification tags;

•   Tag readers – stick and pane readers;

•   Indicators to record weights and collect data;

•   Bar code printers and scanners;

•   Lap tops, IPads and smartphones.

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7   Cooperative Research Centre for Sheep Industry Innovation
    http://www.sheepcrc.org.au/information/about-the-sheep-crc.php

discuss

Student Activity 3: Enhancing sheep well-being and productivity Part 1

This research project is developing methods for ranking sheep so farmers can use existing technologies to gather and analyse data on individual sheep. These technologies provide information on each sheep and improves the farmer's ability to manage the health, welfare and productivity of the flock.

The best time for a farmer to capture automated data on the condition of individual sheep is when sheep are in a confined, familiar space, where they can be more easily handled and managed. There are times in the annual management cycle of sheep raising, when this is more easily managed - such as shearing, pregnancy scanning, weaning and joining.

The video below was taken on the Kirby Research Station at the University of New England, Armidale NSW. **Members of the Enhanced sheep wellbeing and productivity** research program explain the purpose of their research, how the data is being collected and the health, welfare and productivity improvements that result from the use of this data.

This research is being conducted by the Cooperative Research Centre for Sheep Innovation (Sheep CRC).

Watch the video – *Precision Sheep Management (https://youtu.be/HbuKe0IjsbQ)*

Discuss the following.

- The various components used to gather the data.

- The function of the RFID tag.

- The features it can measure and record.

- In what context was the term mob average used?

- What is meant by sheep well-being?

- What livestock handling mechanisms did you notice?

- What implications might this have for managing both the data recording and the necessary analysis and follow up?

Further research will enable you to answer this last question in particular.

As you do, make sure you understand terms such as culling, joining, proprietary software systems and abbreviated terms such as – RBVs and ASBVs.

Suggested steps to follow are outlined in Part 2 of this activity.

task

Student Activity 3: Enhancing sheep well-being and productivity Part 2

"Wellbeing is an increasingly important component of modern sheep production and an important aspect of product quality for consumers," Sheep CRC chief executive James Rowe.

By undertaking your own research, you develop and refine your own knowledge and understanding of what is involved in food and fibre production within the context of the Australian sheep industry. You also start to appreciate the skills sheep producers need so they can adapt to the challenges and opportunities of managing a livestock production system within an increasingly demanding local and global environment.

This provides the context for you to plan and develop an appropriately designed solution for your assessment task.

STEP 1: Find out more about the Enhancing sheep well-being and productivity research project and record you own explanations of the purpose and value of this technology. How is it being applied and how it would assist farmers to make more informed livestock management decisions?
http://www.sheepcrc.org.au/wellbeing.php

STEP 2: Next, find out what farmers have to say. In the links below you will find a number of six case studies. Choose at least six to read yourself. As you do, put yourself in the shoes of these farmers and think about:

• your various responsibilities as a livestock manager - to your family and your livestock, and to the consumers of your products;

• the sustainability of your operations;

• what your priorities would be; and

• critically, the innovations you would introduce to improve the efficiency and sustainability of the operation if you were managing it.

Young Smart and Ready Case Studies – CRC Sheep (Select from the first six listed)
http://www.sheepcrc.org.au/information/young-smart-and-ready-case-studies.php

Target 100 Website
http://www.target100.com.au/Farmer-stories

Merino Wool website
http://www.merino.com/wool/the-source/the-science-of-sheep/

STEP 3: Discuss with your teacher the ideas you have come up with for developing your technology solution. Your teacher may give you a copy of the assessment task at this stage.

Activity 4: Data analysis in precision sheep farming

Background information for teachers

This activity enables students to work with raw data samples provided by the CRC Sheep research team involved in the Enhanced sheep well-being and productivity project as explained in the accompanying video - *Precision Sheep Management (https://youtu.be/HbuKe0IjsbQ)*

Students may want to view this video again.

Each student requires a copy of both pages of the Activity 4 worksheet for their data analysis. It contains the link to the raw data (excel spreadsheet)

The data set showing worked examples can be downloaded below.

*Sheep – Example data set with answers
(http://www.fas.org.au/wp-content/uploads/2016/03/Precision-Sheep-data-set-with-answers.xlsx)*

Depending on the detail that students require for their chosen technologies specialisation, encourage students to investigate issues such as sheep feeding and nutrition, genetics and selection, livestock biosecurity plus various diseases that impact on sheep productivity such as fly strike, foot and mouth disease, livestock parasites.

Advise students that the following websites may also assist them decide the focus of their assessable task.

Government of Western Australia - Department of Agriculture and Food
https://www.agric.wa.gov.au/livestock-parasites/managing-flystrike-sheep

Meat & Livestock Australia
http://www.mla.com.au/Research-and-development/Animal-health-welfare-biosecurity/Parasites

Student Activity 4: Data analysis in precision sheep farming Part 1

task

Precision Sheep Management (PSM) focuses on managing individual or selected groups of animals to take advantage of the large variation between animals within a flock. It requires accurate measurement, selection, management and marketing strategies.

The short video below provides valuable and practical advice to farmers using the technology. 3 simple steps to using eID *https://www.youtube.com/watch?v=EL7n6U6decI*

In the words of CRC Sheep researcher - Laura Kemmis¬ in the video
Precision Sheep Management (*https://youtu.be/HbuKe0IjsbQ*)

"Animal welfare is a really important part of the research we doing here…...Information gives you a lot of power to make to good informed decisions."

The raw data set below has been provided for students by the CRC Sheep research team. It will enable you to perform the same data analysis that farmers do when they analyse data obtained from their monitoring technologies.

The data placemat below shows the different categories of data included. The complete data set you will be interpreting contains data collected from a sample of 150 ewes. Look closely at the data in the excel spreadsheet below and make sure you understand what it shows, before you access and analyse the complete data set.

Gathering data of this complexity would be impossibly time consuming and most likely inaccurate without the technology now available.

Sheep Live Data Placemat

	A	B	C	D	E	F	G	H	I	J	K
1	EID	VID	Breed	Breech Wrinkle - Aug 2014	Foetal number - Nov 2014	Liveweight - Feb 2015	Liveweight - early pregnancy - June 2015	Fleece weight - July 2015	Foetal number - July 2015	Liveweight - mid pregnancy - Sep 2015	Liveweight - post lambing - Nov 2015
2	982 123499519200	08A0018	Merino	4	1	61.6	58	5.4	2	60	55
3	982 123499519167	11A0011	Merino	4	1	51.2	48.6	4.5	1	52.8	48
4	982 123499519067	12A0003	Merino	4	1	53.8	57.5	5.6	2	56.6	49
5	982 123499519314	12A0013	Merino	4	1	60	67	6.2	2	63	54.5
6	982 123499519035	12A0028	Merino	4	1	36	45.5	3.3	2	45.2	47.5
7	982 123499132243	08A0001	Merino	3	1	50.6	53.2	4.5	1	58.8	55
8	982 123499132232	08A0002	Merino	3	1	54	53.2	3.8	2	57.4	47.5
9	982 123499132226	08A0003	Merino	3	1	57.4	63	5	1	63.2	57.5
10	982 123499132210	08A0008	Merino	3	1	52.2	56.2	3.3	2	62	51.5
11	982 123499132112	08A0015	Merino	3	2	46	48	3.1	1	48	45.5
12	982 123499518689	08A0016	Merino	3	0	57.8	59	5.5	1	60.8	55.5

task

Student Activity 4: Data analysis in precision sheep farming Part 2

You be the sheep manager. Assume you have followed the advice in the video - **3 simple steps to using eID** and have collected your required data. You have finished your tasks for the day and have scanned 150 ewes. However, before you let them out of the yards, you have some important work to do tonight analysing your data.

Precision Sheep data set
(http://www.fas.org.au/wp-content/uploads/2016/03/Precision-Sheep-data-set-.xlsx)

Your teacher may have to help you construct a pivot chart. Work through the tasks and record your answers.

1. Highlight the sheep with a breech wrinkle score of 4.   These need to be culled from the mob as a high breech wrinkle score increases a sheep's susceptibility to fly strike.

2. Use a pivot table to calculate the average weight of the sheep. Use data from February 2015. Next, show this information separately for the two breeds. Were the results as expected – why might this be? Refer back to the sheep breeds chart to refresh your memory what these two types are usually bred for.

3. Calculate the average weight gain of the ewes between early pregnancy and mid pregnancy. There are a number of stand-out results. Which breed does this reflect?

4. The amount of wool and number of lambs that ewes produce each year are vital to farm profitability. Identify 15 ewes with the highest fleece weights that have also produced twin lambs in both 2014 and 2015. Filter data so only the twin ewes are shown (for both years), then sort fleece weight in descending order.

5. Pregnant ewes can be scanned with an ultrasound to determine how many lambs they are carrying (i.e. foetal number). Using foetal number data, calculate the expected lambing percentage for 2014 and 2015. Lambing percentage = (total foetal number/total ewes) x 100.

6. Using the appropriate graph, create a frequency distribution diagram of BCS (body condition score) for all sheep - June 2015. Use a pivot table to summarise your data.

Having interpreted the data – identify your priority tasks for tomorrow.

•   How many ewes will you have to separate out for preventative flystrike treatment?

•   BCS determines nutritional well-being. Ideal score is between 2.5 and 3.5. In order to meet your sustainability target for pasture management, how many ewes should you cull? Why is this done?

•   Your neighbour is buying five of your best ewes for some selective breeding. He wants to view them tomorrow and has phoned asking what breed they are. What will you tell him?

Share your answers with your teacher and other members of the class.

assess

Assessment: Data analysis in precision sheep farming

Your task is to plan and produce a designed solution that will assist you and other sheep farmers in their efforts to manage their production management systems better.   Think about the data you have just analysed and how it helped you deal with your management priorities before you let the ewes back out into their respective paddocks.   Did you have the five ewes that your neighbour wanted to buy ready for him to take away? Were they all merinos?

Your designed solution doesn't have to be large, it could be a minor innovation – such as physically managing a number of animals at any one time, a method for detecting and eradicating infestations and diseases, a better method for transporting your livestock and/or their wool. Maybe even an innovation that will keep the sheep fleece clean.

If you were critically assessing a technological innovation, you would need to ensure that the technology:

•   delivers the desired outcomes – e.g. increases productivity and sustainability;

•   is affordable and people have the skills to use it appropriately;

•   ensures that information gathered from data collection and monitoring can be effectively integrated in simple to use computer based applications.

To help you decide on your designed solution, access the link below to the Pedigree Matchmaker and the benefits this use of RFID technology can bring to a sheep breeder.
http://www.sheepcrc.org.au/wellbeing/measuring-recording-and-decision-making/-pedigree-matchmaker-matching-lambs-to-ewes.php

Plan your designed solution:

1.   Decide what is needed, why it is needed and how you will produce it.

2.   Is it practical and affordable?

3.   Establish your success criteria e.g. does it contribute to:

•   Increased productivity?

•   The sustainability of my livestock operation?

•   Greater efficiencies such as saving time, reducing cost etc?

•   Improved animal health and welfare?

You will be required to demonstrate and present your designed solution to the class. Further you will also need to explain how you will promote and market your innovation.

Online Teacher Support Resources

web

1. Australian Bureau of Agricultural and Resource Economics and Sciences
   http://www.agriculture.gov.au/abares/publications/display?url=http://143.188.17.20/anrdl/ DAFFService/display.php?fid=pb_agcomd9abcc20151208_11a.xml

2. Australian Government: Department of Agriculture and Water Resources
   http://www.agriculture.gov.au/ag-farm-food/meat-wool-dairy/wool

3. Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC)
   http://www.sheepcrc.org.au/

4. CSIRO
   http://www.csiro.au/en/Research

5. CSIRO
   http://www.csiro.au/en/Research/Farming-food

6. National Farmers Federation
   http://www.nff.org.au/commodities-wool.html

7. Managing Flystrike in Sheep
   https://www.agric.wa.gov.au/livestock-parasites/managing-flystrike-sheep

8. Meat and Livestock Australia (MLA)
   http://www.mla.com.au/Prices-markets/Trends-analysis/Fast-Facts

9. Meat and Livestock Australia (MLA) Australian - meat.com
   http://www.australian-meat.com/Foodservice/Proteins/Lamb/Why_Australian_Lamb_/

10. Meat and Livestock Australia
    http://www.mla.com.au/Research-and-development/Animal-health-welfare-biosecurity/ Husbandry/Ear-tagging-and-ear-marking

11. Preventing Lice in Sheep
    http://www.liceboss.com.au/prevention.php

12. Rural Industries Research and Development Corporation - Rural Industries Futures
    https://rirdc.infoservices.com.au/items/15-092

13. Rural Industries Research and Development Corporation RIRDC
    http://www.rirdc.gov.au/about-rirdc

14. The Story Behind Wool Australian Wool Innovation Limited (AWI) merino.com for fashion
    http://www.merino.com/wool/the-source/tasmanias-last-frontier/ - myModal

15. Young Smart and Ready Case Studies – CRC Sheep
    http://www.sheepcrc.org.au/information/young-smart-and-ready-case-studies.php

Cover images

Researchers at Kirby Research Farm, by Jason Henry, Welcome to the Fold, for AgriFood Skills Australia

eID Scanner, CRC Sheep, for AgriFood Skills Australia

TrueTest XR 3000, CRC Sheep, for AgriFood Skills Australia

Portable wand, CRC Sheep, for AgriFood Skills Australia