FOREST LEARNING

Teacher

Agroforestry - Trees at Work on the Farm

Photo: B. Welden. Stewart family's Yan Yan Gurt West Farm

Teacher Overview

This lesson is designed to introduce to students some of the management decisions and advantages of incorporating agroforestry into a farming enterprise. Agroforestry aims to achieve the dual purpose of improving the environmental sustainability of a farming system, whilst also producing a commercial and profitable timber product. The incorporation of trees on farms produces shade and shelter for pastures, crops and animals (which positively impacts on their respective yields), improved water quality, diversification of the farming business, and can lead to significant mitigation of soil degradation issues such as erosion and salinity.

This teaching resource utilises a number of teaching strategies and activities including brainstorming sessions, Kahoot! online quizzes, physical modelling of plantation orientations, designing an experiment, poster presentations, viewing current multimedia agroforestry in action case studies within Australia, and graphing activities. By engaging in this topic, teachers will be able to educate students on an important and practical way of incorporating more trees into farming enterprises for sustainability and profitability.

FOREST LEARNING

Teacher

Stage

Years 9-10*: Agricultural Technology

* The following teaching resource has been designed primarily for a year 9-10 Agricultural Technology class studying the incorporation of sustainable measures into a farming enterprise. The theory and activities however, pertain to a number of areas within the Australian curriculum and can be used in the senior years as well. Teachers may wish to select components that are relevant to their areas of teaching.

Syllabus Links

Australian Curriculum outcomes

ACSSU112: Interactions between organisms, including the effects of human activities can be represented by food chains and food webs
ACSIS124: Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge
ACSIS125: Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed
ACSIS126: Measure and control variables, select equipment appropriate to the task and collect data with accuracy
ACTDEK032: Analyse how food and fibre are produced when designing managed environments and how these can become more sustainable
ACTDEK044: Investigate and make judgments on the ethical and sustainable production and marketing of food and fibre.

NSW BOSTES Agricultural Technology outcomes

4.4.1: Examines the impact of past and current agricultural practices on agricultural sustainability
4.4.2: Identifies aspects of profitability, technology, sustainability and ethics that impact on management decisions
5.4.1: Evaluates the impact of past and current agricultural practices on agricultural sustainability
5.4.2: Evaluates management practices in terms of profitability, technology, sustainability, social issues and ethics
5.5.1: Designs, undertakes, analyses and evaluates experiments and investigates problems in agricultural contexts

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Table of Contents

Lesson Activities

NOTE: All resource links and writing space for student responses are provided within the student worksheet resource.

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1.2: Kahoot Forestry Quiz	10
1.3: Trees for windbreaks	10-15
1.4: Who owns Australia's plantation forests graphing activity	10-15
1.5: Modelling plantation orientations	20-30
1.6: Multimedia Australian agroforestry case studies	20
1.7: Kahoot Quiz	10
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2.2: Brainstorming and poster presentation	30-40
3.1: What variables would you measure?	5
3.2: Brainstorming	5
3.3: Sketch of experimental design	15
3.4: Experiment – write up and performing	60-80
4.1: Multimedia case study	5
4.2: Research investigation of a regionally significant forestry species.	30-60

Activity 1

Activity 1.1: Trees on farms brainstorm

Teacher preparation:

- Photocopy and hand out a copy of the Agroforestry student lesson resource to each student.
- *Optional*: access an area on the school that allows students to observe some of the roles of trees in action.

Activity Outline:

- To gauge your students' knowledge and understanding of the importance and role of trees in a farming ecosystem, conduct a short brainstorming session on the topic and have students collate their data on their worksheets as you record the ideas on the board, smartboard etc.

- Optional: you may wish to conduct this brainstorming session as you walk students around the school or on the school farm to allow them to visualise components such as:
    - Improving organic matter content in the soil
    - Stabilisation of soils
    - Shading
    - Shelter from wind etc.

- After the completion of the brainstorming session, in order to introduce some statistics about the forestry industry, have students complete a short Kahoot Quiz.

Activity 1.2: Kahoot! Forestry Quiz

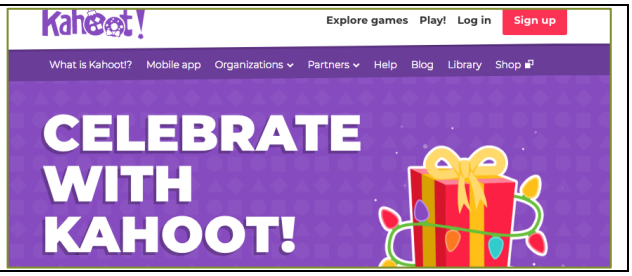
Teacher preparation:

- Access Kahoot! Link
  URL: https://play.kahoot.it/#/k/c773f958-4b76-4fcb-9528-bcccbf525b4d
- Order a class set of iPads/computers, computer lab or allow access to BYOD to complete the Kahoot! quiz.

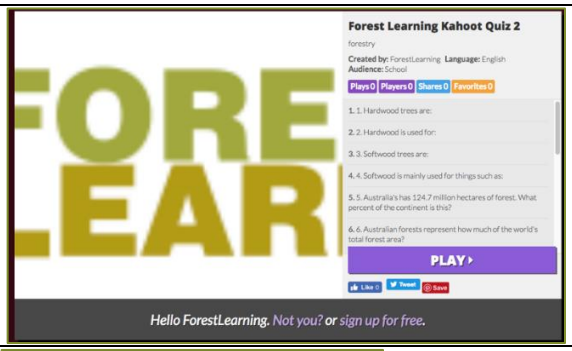
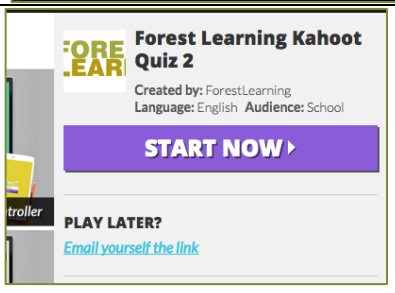
Kahoot! Instructions for first time users:

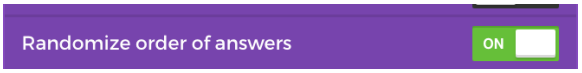
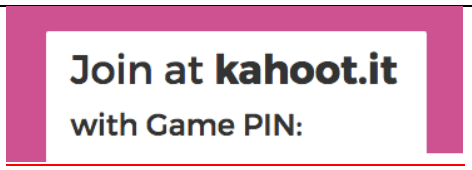
Teachers can either:

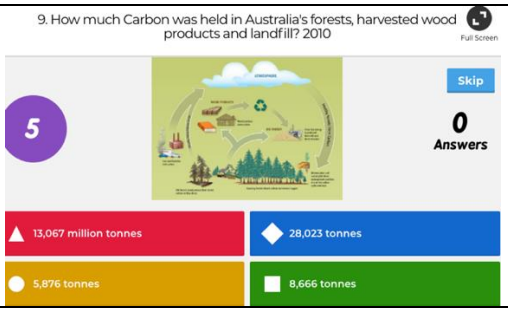
1. Use their own account

Sign up to Kahoot! with their own account (which is a quick and easy process) and search for: "ForestLearning Kahoot Quiz 2" URL: https://kahoot.com/welcomeback/	

2. Use the ForestLearning account

a) Access the ForestLearning Quiz directly from the link provided. URL: https://play.kahoot.it/#/k/c773f958-4b76-4fcb-9528-bcccbf525b4d	
b) Teachers should then select the PLAY option and the START NOW option	

c) It is then very important to then scroll down and select the option RANDOMIZE ORDER OF ANSWERS from OFF to ON option. d) At this point, teachers will need to select either CLASSIC (individual student) or TEAM MODE.	
e) Ask students to go to URL: https://kahoot.it/ on the device they are using.	
f) Teachers will be provided with the screen right that details a pin for students to type into their device to begin the game/quiz.	
g) Students should enter a nickname and press OK, go.	
h) When the teacher starts the game, students will be able to view the question screen and the answer options appear on their devices as a colour and shape option which they should select (an example is provided below).	

Example ForestLearning Kahoot! Question →	

Introduction to Agroforestry:

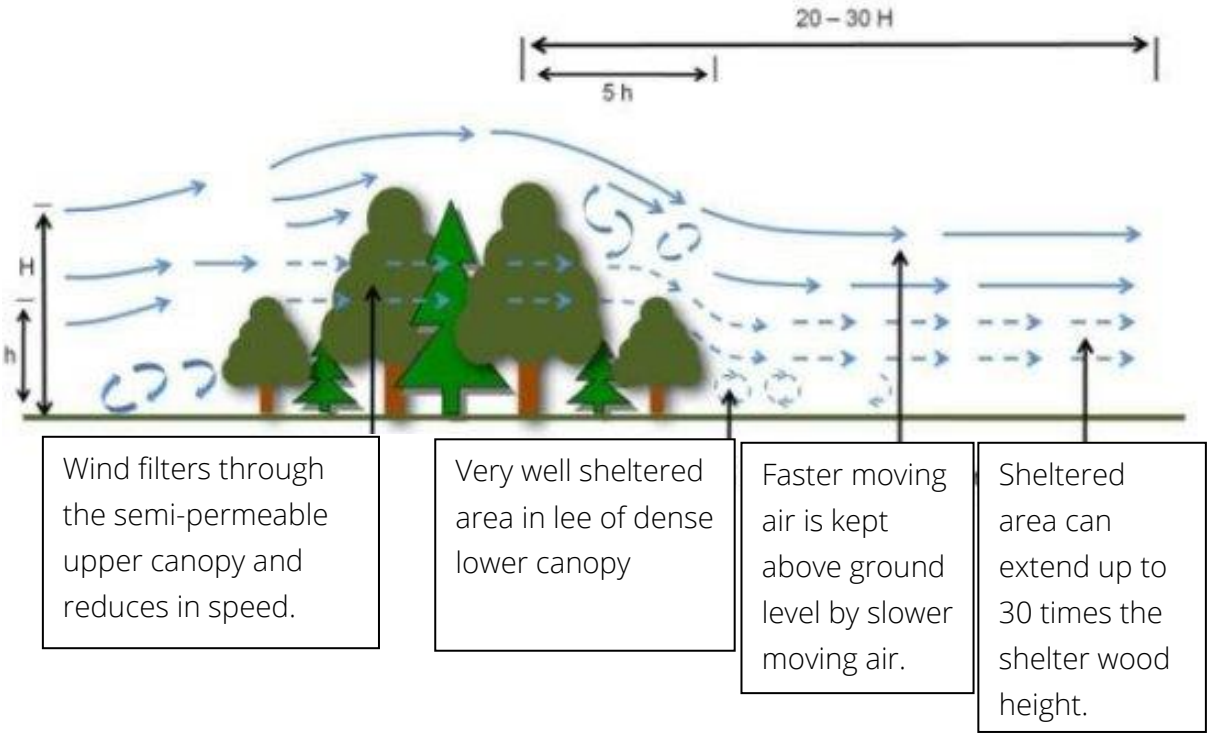
a) Teachers will introduce the theory and definition of Agroforestry to the class (notes are provided on the student worksheet).
b) Students should highlight their notes.

Activity 1.3: Windbreaks

Activity Outline:

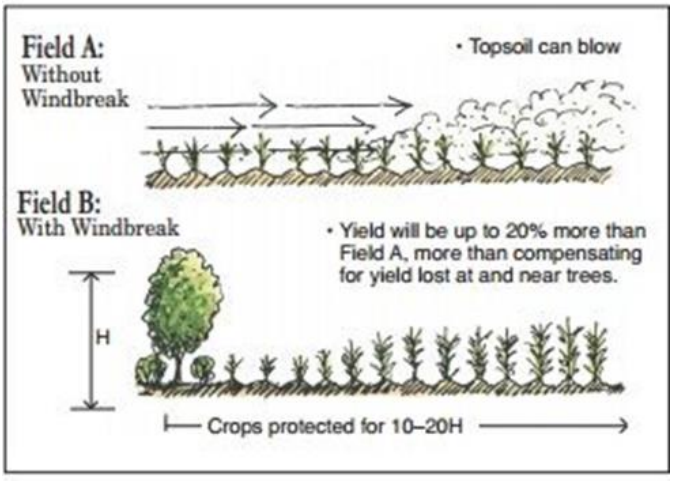
a) Teacher's will define the term windbreak for students (**A windbreak is a plantation made up of one or more rows of trees and/or shrubs for the purpose of wind protection and shelter for vegetation and/or livestock)** and use it as a common example as to why producers would make a management decision to incorporate a windbreak for specific areas on their farming property.
b) Teacher's will assist students in annotating the features of a windbreak onto **Diagram 1** (this could be projected on screen or drawn on the board etc.) and identify the importance of windbreaks to students.

DIAGRAM 1 ANSWERS:



c) Other possible Information to include in the supplied box or to annotate around the diagram could include:

- The main impacts of not implementing a windbreak are wind erosion, physical damage to plant structure and lodging and animal losses due to cold winds and heat.
- The height of a windbreak is crucial in how it can protect the area behind it and how far this will extend.
- On flat ground the windbreak will lower the speed of the wind for a distance that is approx. 25 times greater than the height of the trees.
- The length of a windbreak is also important, and it is suggested that they should be 12 times the height of the trees in length.
- The number of rows of trees is important and taller trees should be planted in the centre and bushier, shorter trees on the outside of the taller trees.
- Scientific studies have demonstrated that well-designed shelterbelts can increase yields by 20-30% over a distance of 10 to 12 times the height of the trees.
- Adequate shelter for livestock can prevent death from exposure of newborn lambs and newly shorn sheep.
- In hot areas, shade from trees can improve both crop and stock performance.



Additional reading for teachers:
URL: http://www.crec.ifas.ufl.edu/extension/windbreaks/pdf/AustralianWindbreaks.pdf

Source: *Trees for Shelter. Windbreaks for Australian Farms*

Activity 1.4: Who owns Australia's plantation forests?

Students will graph data from ABARES pertaining to ownership of plantations in Australia, to gain an understanding of the changes in trend over time and to develop their graphing and analysis skills.

Teacher preparation:

- If completing the graphing activity on computer, students will need an appropriate graphing / program to complete it (e.g. Excel).
- Class set of computers / IPads
- Colour pencils and rulers (if graphing by hand).

Activity Outline:

- Students are to view the data in Table 1 and graph the trend over time from 2004-2016 of plantation ownership in Australia.
- After graphing the data, students should answer the question on the trend of ownership.

OPTIONAL: Teachers have the option of presenting to students the multimedia Landline Tasmanian agroforestry case study. This segment is an excellent introduction to agroforestry and could be used as a class discussion point or if teacher's have limited time it could be used as a homework or extension task for students to view.

URL: http://www.abc.net.au/news/2017-11-05/standingtall:-tasmanias-forestry-future/9138056

Source: *Standing Tall: Tasmania's forestry future, Landline ABC, 2017. (16.24)*

Activity 1.5: Modelling plantation orientations

Students as groups or Individually, will work to create a set of physical models showing the formation of trees in different orientations and then sketch them in a diagram or photograph them.

Teacher preparation:

- Playdough
- Toothpicks or model trees
- Access to description cards
- Class set of computers/ iPads,

Activity Outline:

- Teachers should choose how to provide students with the information on the description cards by: dictation, displaying them as workstations, teaching from the board etc. (depending on the teacher's preference).

- Students can supplement this information with internet research to view images and read further descriptions of tree orientations.

- Students should use the provided materials to create models of all the orientations.

- At this point in the lesson, it is encouraged that teachers facilitate a discussion of where on a property the particular orientation would be best suited and why.

    - For example, while students are able to manipulate and mould their playdough, encourage them to create a slope/hill and think about what orientation may most effectively reduce erosion or the movement of water across a slope and where the trees may be best suited on the slope (e.g. top, middle or bottom).

Example of a playdough model windbreak

- When students complete their models, they should either sketch their images or photograph their models and add them to the provided table.

- On page 11 of the Student Workbook, students should then complete a whole farm sketch, annotating and drawing as many of the orientations that they have modelled above in the appropriate places on the farm. An example can be seen on page 5 of the URL: http://lrrpublic.cli.det.nsw.edu.au/lrrSecure/Sites/Web/hsc_agriculture/lo/6943/documents/41565_Part1.pdf

  Source: *Department of Education and Training, Sustainable Farm Production*

Agroforestry orientation descriptions

Plantations
Are generally big blocks of trees that consist of the same species grown for timber production that are planted at the same time. The trees are in rows that are evenly spaced between the trees and also between the rows.

Woodlot
Are a small area of clumped trees / block of trees.

Wildlife corridor
Is a line of trees that join areas of forest together across a landscape. These corridors allow the movement of animals from one area to another and encourage the biodiversity of native organisms.

A suggested source to show student's during this activity is:
URL: https://homelover.com.au/planting-trees/
Source: Where are we planting trees; diversifying the Yarra Yarra.

Windbreaks
Contain rows of trees and smaller shrubs that serve to protect crops, pastures and livestock from wind.

Alleys
Trees are grown in many rows across the farm. In the spaces between the tree rows, crops are planted, and livestock can be grazed.

Activity 1.6: Multimedia Australian agroforestry case studies

Students will view three multimedia sources to gain a knowledge and understanding of how trees can be a profitable source of income on a property and how they can be introduced into a traditional farming enterprise. During this phase of the lesson, teachers should continually draw student's attention to the management decisions being made by the producers in planning the planting of the trees, looking after the growth phase of the trees and in the production and harvesting of the final timber product.

Teacher preparation:

- If performing this activity as an individual task, teachers should access a class set of computers/ computer lab or IPads to enable students to view the multimedia sources or project the sources on screen if conducting the activity as a whole class task.

Multimedia One:

URL: https://www.youtube.com/watch?v=4b26zrkwIPU&feature=youtu.be
Source: *Low Impact Sustainable Agriculture – Regenerating the Family Farm* ***(4.28)***

Multimedia Two:

URL: https://www.youtube.com/watch?v=X5U_UyMRCZc
Source: *Native Forest Management – Private Forestry Service Queensland* ***(7.28)***

Multimedia Three: (4.58)

URL: https://youtu.be/K0cMpP7iE1g
Source: *Going Bush 2015 EP02 Private Forestry Service QLD, YouTube Segments.* ***(6.07)***

Activity Outline:

- Students should view the three case studies and take notes in the provided table on the advantages that are discussed in the sources.
- Students will complete a Kahoot! quiz on the content of the material in the following task.

Activity 1.7: Multimedia Kahoot! Quiz

Teacher preparation:

- Access Kahoot! Link
  URL: https://play.kahoot.it/#/k/b7e9cac0-c564-4481-8775-06237b21e47d
- Order a class set of iPads/computers, computer lab or allow access to BYOD to complete the Kahoot! quiz

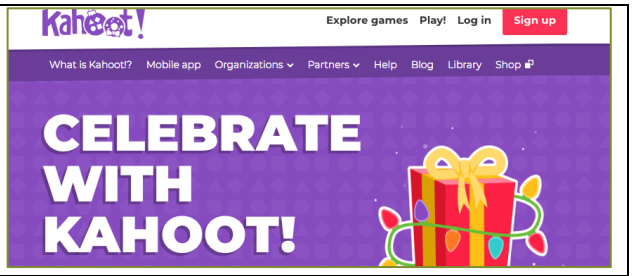
Activity Outline:

- Teachers should follow the instructions below to access the game.

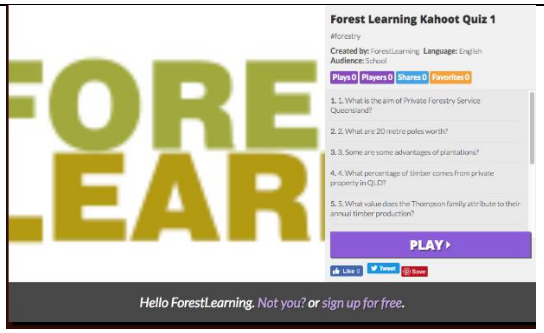
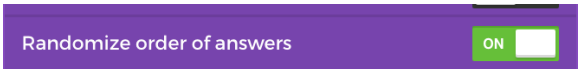
Kahoot! Instructions for first time users:

Teachers can either:

1. Use their own account:

Sign up to Kahoot! with their own account (which is a quick and easy process) and search for: "ForestLearning Kahoot Quiz 1" URL: https://kahoot.com/welcomeback/	

2. Use the ForestLearning Kahoot! Account:

e) Access the ForestLearning Quiz directly from the link provided. URL: https://play.kahoot.it/#/k/b7e9cac0-c564-4481-8775-06237b21e47d	
f) Teachers should then select the PLAY option and the START NOW option	
g) It is then very important to then scroll down and select the option RANDOMIZE ORDER OF ANSWERS from OFF to ON option. h) At this point, teachers will need to select either CLASSIC (individual student) or TEAM MODE.	
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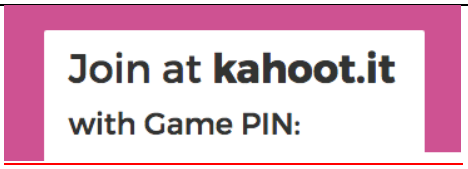
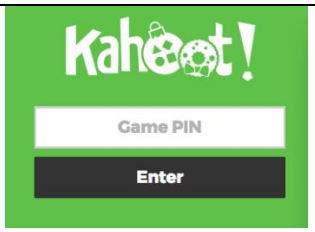
j) Teachers will be provided with the screen right that details a pin for students to type into their device to begin the game/quiz.	
k) Students should enter a nickname and press Enter	
l) When the teacher starts the game, students will be able to view the question screen and the answer options appear on their devices as a colour and shape option which they should select (an example is provided below).	

Example ForestLearning Kahoot! Question →	

Activity 2

Students will gain an understanding on the consequences of the decision to remove deep rooted vegetation and draw a link as to why it is crucial to address these issues through more sustainable methods of farming.

Benefits of trees on farms

- Teachers and students should read and highlight the introductory segment on the history of the removal of trees and the short description of how salinity was caused by the removal of vegetation.

Activity 2.1: Photographic comparison study

Teacher preparation:

- Images of the three photos that were taken at the same location but on three different dates could be projected onscreen for discussion as students are completing the task.

Activity Outline:

- Students will observe the three photos showing a timeline of changes at a location over the period of 1994-2013.
- Students should record their observations based on the visual changes.
- Teachers should encourage students to hypothesise what the producers did to cause these changes.

Activity 2.2: Brainstorming Session and Poster Presentation

Students will have the opportunity in this activity to collate the information they have learnt about trees on farms and present it as a promotional poster publicising the advantages of agroforestry.

Teacher preparation:

- Poster materials or class set of computers/ iPads etc.

Activity Outline:

- Select two students to record the information during the brainstorming session
- The class should have the opportunity to collate their knowledge and understanding of trees and Agroforestry. This activity is a way for teachers to measure how well students

have understood the main principles so far. A set of questions has been provided on the student worksheets to facilitate the discussion. You may like to allocate other students to coordinate the brainstorming session.

- After this session, students can use additional internet sources (an example of a site is provided to assist students) to create a promotional poster supporting the adoption of agroforestry into a farming environment.

  URL: http://www.farmforestline.com.au/pages/2_why.html
  Source: *Farmforest Online, Why Plant Trees? (and associated subheadings at the bottom of the web page).*

Activity 3

Rationale

Throughout the Agricultural Technology / Science / Australian Curriculum syllabus there is a significant focus on the importance on students developing skills in planning, designing and conducting experiments. This activity focuses on the skills of students working in groups to design a field trial that would be effective in testing the effects of agroforestry on an aspect in the environment.

Field trials offer different challenges compared to the in-class experiments students will be familiar in conducting, especially when considering controls and controlled variables. For example, when attempting to test variables in a given sample paddock, there may be issues of uneven slopes, differing soil profiles within the area, different water table characteristics, and seasonal variations etc.

The purpose of this activity is not to collect and analyse specific data. indeed, it will be difficult for any school to access a relevant plantation area, windbreak etc. Instead, the focus of Activity 3 is primarily for students to attempt to design a valid and reliable study, and engage in the process of collating data and discussing how the elements of experimental design could be addressed in such a study.

Quantifying Success in Agroforestry

Students will read an introduction to quantifiable data and the types of data that producers may be interested in collecting and analysing on their properties.

Activity 3.1: What variables would you measure?

Activity Outline:

- Teachers may wish to introduce this activity by referring to a experiment student's may have conducted previously.
- Teachers should discuss the elements of the experiment and the requirements that make and experiment valid, accurate and reliable.

Reliability refers to an experiment with results that are obtained consistently. Reliable results include those that are: Repeated and consistent results are obtained.

Repetition will only determine reliability it will NOT improve it.

Reliability can be improved by carefully controlling all variables (except the independent variable).

Accuracy depends on the design of the experiment and the equipment used. An experiment is accurate if: the results are close to the true value of the quantity being measured and they are substantiated in secondary sources.

A valid experiment is a fair test. An experiment is valid if:

- The hypothesis is tested by the method,
- Suitable equipment is used,
- Variables are controlled,
- Measuring units are included.

- Students should be allocated some individual brainstorming time to think of as many variables that could be tested in an agroforestry area that a producer may be interested in. Examples may include, but are not limited to:
    - Changes in salinity,
    - Measuring soil moisture,
    - Impacts on pH, texture, organic matter of soil etc.,
    - Changes in fertility (cation exchange capacity),
    - Changes / variation in wind speed,
    - Changes in percentage cover of vegetation.

Below is a link that can be viewed to see a demonstration of measuring vegetation characteristics in an area:

URL: http://oregonstate.edu/instruct/bot440/wilsomar/Content/HTM-perarea.htm

Source: How to measure: Measuring vegetation characteristics per area

These variables could be tested in different ways:

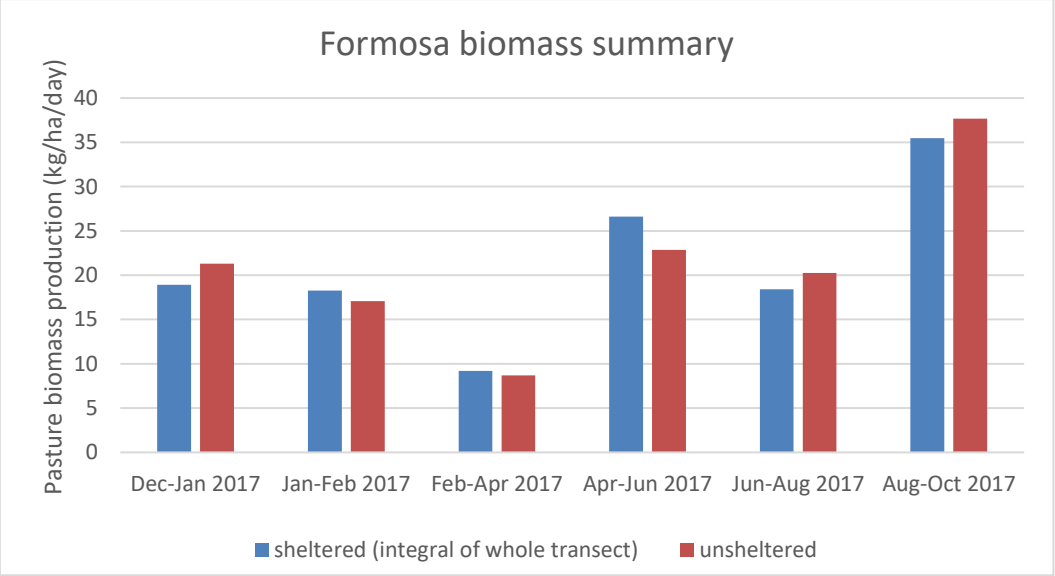
1. Over a period of growth time of the plantation establishment (e.g. how does salinity change over the growth months/years of the plantation?).
2. With increased distance away from a plantation or trees in question (e.g. how does salinity change as you move away from the plantation by x, y, z distance?)
3. It is often difficult, or not feasible, to achieve a "control" in an exact sense in some field trials but ideally, there would be one field sample area without the plantation for testing that was "exactly" the same (soil, pasture, environmental impacts etc.) as the field sample area with the agroforestry area so there could be a comparison of data. For example, start with two areas that are affected by salinity. Establish a plantation in the area of one and not the other and over time record changes in salinity / water table changes etc.

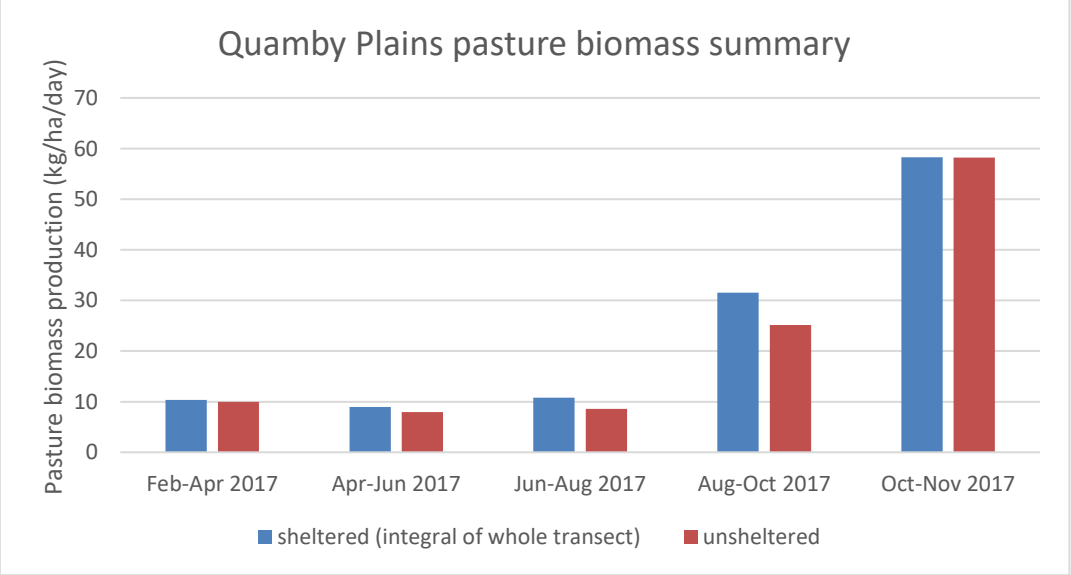
Current Research Example: (Dr Martin Moroni, Private Forests Tasmania; Dr Daniel Mendham, CSIRO and Dr Thomas Baker, University of Tasmania)

Data is currently being published by the CSIRO, Private Forests Tasmania and the University of Tasmania with funding from the Australian Research Council, that is focused on "The Effect of Shelter Belts on Microclimate and Pasture Productivity". This scientific study analysed microclimate and pasture yield data in caged (to keep out grazing) tree sheltered and unsheltered areas on a farm.

Some preliminary averaged results can be viewed in the graphs below. This data could be shared with students before planning their experiment to demonstrate a real-life example of a field trial that Australian scientists have conducted to assess the benefits of agroforestry on a grazing farm.

The Effect of Shelter Belts on Microclimate and Pasture Productivity.





With special thanks to: Dr Martin Moroni, Private Forests Tasmania, Dr Daniel Mendham, CSIRO and Dr Thomas Baker, University of Tasmania and the Australian Research Council for permission to use this clumped data within this teaching resource.

Activity 3.2: Brainstorming

Activity Outline:

- After students have had time to think about their own measurable data, the class should collate their ideas about a topic that could be tested.
- Depending on time, resources and class size that you have to invest in this task, teachers will need to decide whether to choose one variable as a whole class to investigate, or whether to assign groups to test different variables etc.

Activity 3.3: Sketch of experimental design

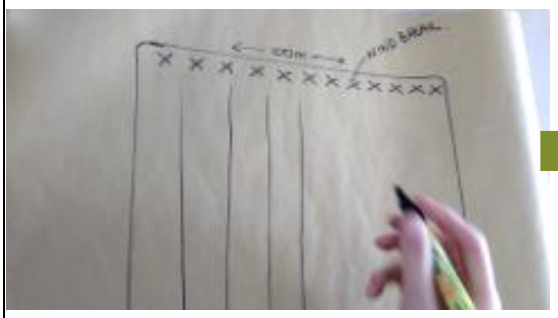
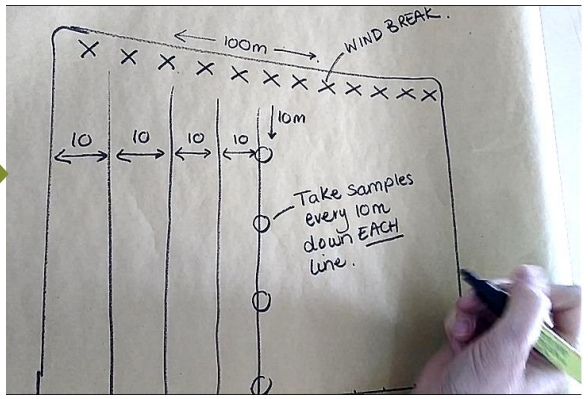
Teacher preparation:

- Plan an area of the school, or a agricultural industry partner property, to conduct the experiment.
- Order all equipment necessary (will vary depending on the topic/s students have selected).
- Complete any risk assessments that are necessary.
- Allocate students into groups with specific areas to test

Activity Outline:

- The table below is an example of how teachers may choose to design and conduct the study with their students. There are many variations on how this could be performed.

Step	Description
1	Allocate a suitable area of the school (or agricultural industry partner property) where the experiment could be conducted. An example could be adjacent to the school oval if there are trees planted nearby – or with an imaginary 100m windbreak along the sideline. Or Students could divide the field into two, and create an imaginary windbreak through the middle of the field and proceed to test either side of the "windbreak" for sheltered and unsheltered data.

2	Design a sketch of the sample area and allocate students to particular area to test. Activity 3.3. The sequence of sketches below gives you a quick visual idea of how to start students with their experimental plan using butchers paper or similar. The sketch should be added to with allocated group names etc.  
3	Allocate groups if necessary, and determine how many samples students will be testing and collecting across the trial area.
4	Write a list of the necessary equipment you and your students will need to order to conduct the experiment and a risk assessment if required. Examples of equipment may include; tape measures, cone markers, iPads, collating software, pH test kits, data loggers etc.
5	Discuss the components of randomisation, standardisation, replication, controls, independent and dependant variables and factors of validity, accuracy and reliability that are specific to your class' experimental study.

Activity 3.4: Experiment

Teacher preparation:

- Class set of computers if not handwriting the experimental design into the spaces provided.

Activity Outline:

- In this section of the lesson, students will have the opportunity to write up their experimental design as a group project.
- Teachers may wish to use an alternative format to record the experiment.
- When the class/group have designed their method, they should be given the opportunity to conduct their experiment.
- At the conclusion of the experiment, if data has been collected, teachers may wish to extend the lesson and have students analyse their data.
- If teachers are not analysing data, students should be given the opportunity to respond to the provided questions which offer a reflection on their experiment and its design.

Activity 4

This activity involves students completing a case study of a regionally significant forestry tree with the aim that it could be incorporated into an agroforestry system.

Activity 4.1: Multimedia case study

Teacher preparation:

- Class set of computers or iPads to access the multimedia link.

URL: https://www.youtube.com/watch?v=rVF5qVpkfkk
Source: *Bambra Agroforestry Farm. The Deep Living Project - Exploring Regenerative Living. (5.15)*

Activity Outline:

- Students will view the footage and summarise the three main points that they believe to be the most significant ideas from Rowan Reid.

Activity 4.2 Research investigation of a regionally significant forestry species.

Teacher preparation:

- Computer laboratory/ class set of computers / iPads

Activity Outline

- Students will view the ABARES tables (2 and 3) on their worksheet resource and select either a softwood or hardwood tree of interest in their state/territory.
- Using the internet, they will then complete the table regarding the information on their particular tree and its characteristics and worth to forestry.
- Finally, teachers and students should consider the possibility of sourcing a regionally significant tree and planting it somewhere appropriate on the school grounds for future students to refer to.

Sample Answers

Activity 1

Activity 1.1 and Activity 1.2: Brainstorming and Kahoot! forestry quiz

Answers will vary depending on individual class responses to the brainstorming session. Answers may include: Photosynthesis, carbon storage, habitat for animals, harvestable food and fibre products, shade, shelter, adding organic matter to the soil to improve nutrient status, stabilisation of soil structure, prevention and control of erosion, salinity control.

Activity 1.3: Windbreaks

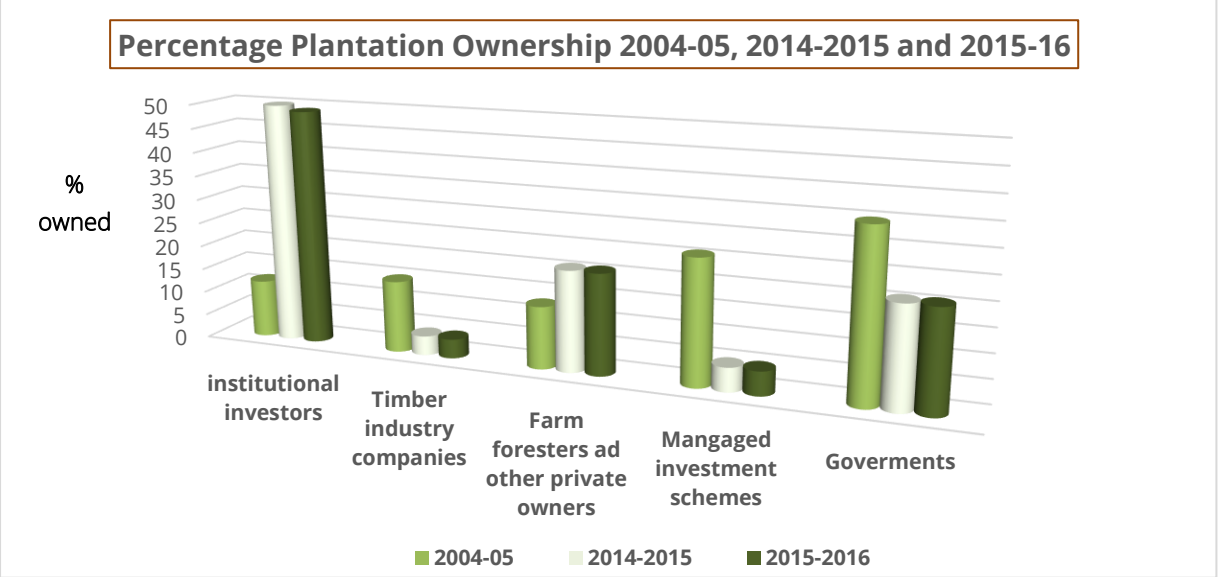
a plantation made up of one or more rows of trees and / or shrubs for the purpose of provide shade and shelter.

Annotations for the A windbreak is: student diagram are shown on page 8 of this Teacher's Resource.

Other information about windbreaks:

Information is included on page 9 of this Teachers Resource. Teachers may choose what is most relevant their classes or select information from their own sources.

Activity 1.4: Who owns Australia's plantation forests?



Question

Describe the trend in percentage ownership of Farm foresters and other private owners' plantations from 2004-2016. Identify which owners have experienced the most significant changes over this period of time.

- From 2004-05 the ownership increased from 13% to 21%.
- Institutional investors have experienced a significant increase from 10% to approximately 50% ownership over the time
- Timber industry companies and managed investment scheme owners have experienced a decrease in ownership over the same time.

Image: B. Welden, The Stewart family's Yan Yan Gurt West farm

Activity 1.4: Modelling plantation orientations

Orientation of trees	Diagram
Plantation	* *
Wildlife corridor	***** ********** ***** ********** ********** ********** **********
Alleys	********** grazing cattle ********** grazing cattle **********
Windbreaks	********** ********** or 
Woodlots	** **** ****** ******* **** *

Whole Farm Diagram with Multiple Forestry Orientations.
Diagrams will vary depending on student's choice of farm and forestry orientations. An example in supplied in the teacher instructions and below.

URL:
http://lrrpublic.cli.det.nsw.edu.au/lrrSecure/Sites/Web/hsc_agriculture/lo/6943/documents/41565_Part1.pdf

Source: *Department of Education and Training, Sustainable Farm Production*

Activity 1.5: Multimedia case studies in Australia

Multimedia One: (4.58)

Economic advantages: new products and new opportunities of products, producing high value timber to sell in the future.

Environmental advantages: restoration of hydrological features (30 m deep creek), invested in infrastructure to improve outcomes, revegetated with 40 000 trees, corridors and well protected landscapes, soil and stock protected.

Social advantages: improves environment for family members working on farm and for the community as well.

Multimedia Two: (6.07)

Economic advantages: demonstrating good returns and values from private forestry, 1 tree $700-$800, good return on thinning's, will cover the costs, $60-80 000 per hectare on high return sites, control of weeds; means that trees will give some return of profit and also control weeds.

Environmental advantages: weed control and suppression, biodiversity increase.

Social advantages: None listed

Multimedia Three: (7.28)

Economic advantages: timber providing additional income, more landholders are investing in this due to profitability, 30% of farm profit from trees each year.

Environmental advantages: 2 trees allowed to regenerate after harvesting, improves habitat potential of area if managed properly.

Social advantages: None listed

Activity 1.6: Multimedia Kahoot! Quiz

Kahoot answers can be accessed by: selecting the option SHOW ANSWERS on the activity screen:

Activity 2

Activity 2.1: Photographic comparison study

Area in 1994

Low levels to zero levels of deep rooted vegetation, varied pasture quality with areas completely sparse and absent of all vegetation, erosion evident and possible salting.

Same view of area in 1999

Uniform grass/pasture cover, significant deep-rooted perennial vegetation has been established, and is growing well, erosion areas have been covered and appear to be stabilised.

Same view of area in 2013

The area is significantly 'forested" with large trees that are very well established and diverse in variety. No erosion areas are evident.

This area has been transformed over the period of time and turned from what visually appears to be an unproductive pasture area to one that is diverse in vegetative mix and stable in terms of erosion risk and supporting plant life.

The management procedures that are most likely to have occurred are; revegetation with diverse and suitable species mix, fencing off to allow no stock onto the area while the trees are being established.

Activity 2.2: Brainstorming Session and Poster Presentation

Answers will vary depending on student responses. Examples are listed below:

1. Why are trees crucial to the sustainability of farms?
   Photosynthesis, transpiration, carbon capture, erosion prevention, salinity rehabilitation and control, shad and shelter, encouraging biodiversity, providing organic matter, water quality,

2. What additional benefits does the implementation of agroforestry offer to producers?
   Additional income from a diversified product. Improvement in economic, environmental and social sustainability. Listing statistical of worth would be recommended here.
3. Should producers manage the introduction of trees by planting a monoculture of forestry species on their farm? Discuss.

   Answers many include ideas of:

   - monocultures (and therefore a producer's loss) may be more at risk in the event of pest and disease infestations as this would affect an entire crop or property.
     - A single species may be affected by climate or other environmental stress and therefore all trees would be susceptible.
     - Additionally, if there is oversupply of a product the price will be affected.
     - However, if the establishment is successful and the product is of high quality and in high demand then financially the producer may benefit significantly.
     - However, diversifying the type of trees that are established will further diversify income, and protect the producer from risks referred to above.

4. What are some of the management strategies farmers need to consider when implementing Agroforestry successfully?
   Whole farm planning, creating a timeline of implementation, species selection, soil preparation, planting, fencing, observing and recording growth, thinning and pruning, market selection.

5. What are some of the issues of choosing NOT to implement a system such as this?
   Positives of not implementing: producers would not have to invest money on implementation and can invest it in other areas of the property, no extra resources and education are needed, therefore no extra time is needed to

establish the plantations.
Negatives of not implementing: Sustainability is affected in both the short and long term (water quality, soil degradation – erosion, salinity, soil structure), pastures/crops/stock are not protected and therefore yields many be affected), no advantages of diversifying income to timber (and other products) are experienced. Cost savings of implementation when thinning stands and at the final harvests can overcome establishment costs and can reap high returns on investment. For example, Yan Yan Gurt Farm in Victoria estimates it's windbreak timber trees will yield $60,000/ha once harvested.

6. If you were a producer would you choose to incorporate Agroforestry on your farm? Why or Why not?
   Answers will vary depending on individual students.

7. What other questions do you have about the topic of Agroforestry that you would like to have answered to improve your understanding of the topic. Answers will vary depending on individual students.

Activity 3

Activity 3.1: What variables would you measure?

Answers will vary depending on the individual student but may include:

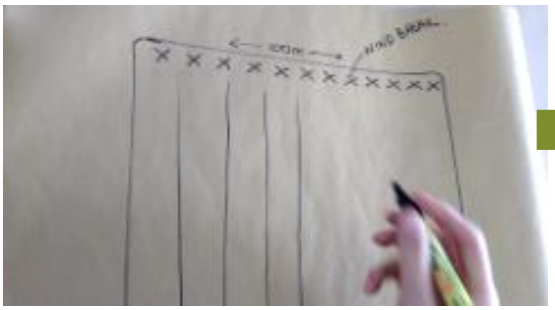
- Changes in salinity
- Measuring soil moisture
- Impacts on pH, texture, organic matter of soil etc.
- Changes in fertility (cation exchange capacity)
- Changes in wind speed
- Changes in percentage cover of vegetation
- Water quality

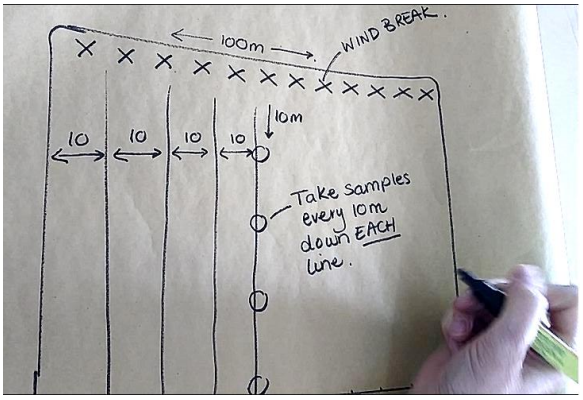
Activity 3.2: Brainstorming

Answers will vary depending on individual class responses.

Activity 3.3: Sketch of experimental design

The sequence of sketches below gives you a quick visual idea of how to start students with their experimental plan using butchers paper or similar. The sketch should be added to with allocated group names etc.





Activity 3.4: Experiment

Answers will vary depending on student responses. Examples are listed below:

Experiment Title

Will vary depending on class choice of experiment.

Hypothesis

Should either support or refute the aim, or state that there will be no effect.

Dependant Variable

The variable that is being tested or measured in the experiment e.g. % pasture cover.

Independent Variable

The variable that is changed during the experiment e.g. distance away from plantation or sheltered vs unsheltered.

Control

The control is the non-treatment group or the “normal” treatment group e.g. Unsheltered pasture.

Controlled Variables

The variables that are held constant e.g. time of day tested, soil type etc.

Variables within the area that may be sources of error or are unable to be controlled

Some examples many include: soil fertility, climatic changes, pest and disease of trees, water availability, water table variations, individual trees genetics.

Methodology

Will vary depending on class choice of experiment.

Data Table

Will vary depending on class choice of experiment.

Questions

Answers will vary depending on student responses. Examples are listed below:

1. Do you believe that your experimental design would be successful in collecting the appropriate data in a "real agroforestry area" to address the aim of the experiment? Why or why not?
   - *Answers may include*: too little data/samples were collected to determine reliability, the equipment was not accurate enough or didn't test the desired variable appropriately, data was not collected over a long enough time to make this a valid one, etc.

2. Identify any changes to the experimental design you would make if performing this experiment again.
   - Changes to: area selection, equipment selection, more samples taken, over a longer time etc.

3. What variables were/ would be the most difficult to control in the experiment?
   - Answers could include: soil type, slope, seasons, water availability etc.

4. Identify any possible reasons why producers may not perform quantifiable trials on their properties.
   - Expense, access to resources, access to consultants, time.

5. Identify reasons why it would be advantageous for producers to perform statistical trials on their property.
   - To determine if agroforestry makes a quantifiable improvement to areas for environmental and economical sustainability.
   - To justify the expense of agroforestry investment (money and time).
   - To be able to use the benefits of agroforestry documented to encourage a greater uptake of implementation of agroforestry by other producers in the region.

- To allow modification of implementation/management strategies to improve future implementations (e.g., some trees may be better performing than others and this would be able to be judged more accurately with quantifiable data).
- To create more accurate calculations of gross margins.

6. Justify the length of time you would need to conduct the experiment for to make it a valid one?

- The more seasons over which the data is collected, across a greater number of years, the more reliable the information collected will be based on the outcomes and impacts of agroforestry e.g., if pasture biomass data is collected only in winter for one year, this will not give an accurate picture of the effects of shelter as it may be an uncharacteristic year for rainfall or other weather variables. The data would need to be collected multiples times (even hourly/daily) across all seasons to provide the greatest validity.

Activity 4

Activity 4.1: Multimedia case study

Three main points of source material.

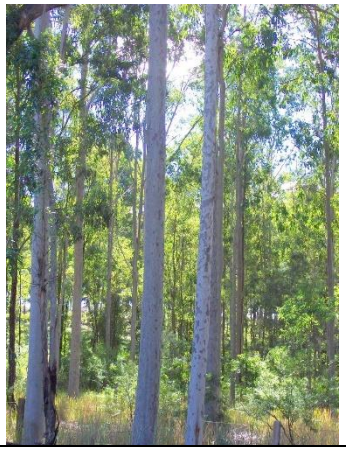
1	Forestry designed to meet the farmers needs cover land degradation.
2	Encourage biodiversity as a motivation.
3	Producers should design their own plan to their own property.

Activity 4.2: Research investigation of a regionally significant forestry species.

Answers will vary depending on individual choice of tree and sites used. Below is an example of answers for a Spotted Gum tree.

Question	Student sample answer
Name of the tree species (common and scientific)	Spotted Gum *Corymbia citriodora subsp. variegata, C. citriodora subsp. citrodora, C. maculata, C. henryi. Family: Myrtaceae*

Important features of species.	• Premium hardwood, (rated 1 on a 6-class scale of hardness) • Structural and appearance uses • Minimal staining timber, less prone to bleeding, will readily accept paint • Suitable for carving and as a woodturning timber • Resistant to termites
Description of the type of timber produced.	• Range of colours • Light-brown to definite browns, deep red-brown hues • Coarse and uneven textured wood • Wavy grains • Slightly greasy feel which assists with machining and boring
Uses of timber	• Engineering applications – construction, • railway sleepers, • posts, poles, • framing, • flooring, • lining, • decking, • cladding, • veneer and plywood, • landscaping, • boatbuilding, • tools that implement high impact forces (e.g. axes), • sporting goods, • indoor and outdoor furniture, • favoured as a smoking and curing medium.
Economic value of the timber to Australia	Due to the lower wood density of younger trees, spotted gum grown in plantations may be suitable for export woodchips or paper manufacturing between seven and 12 years of age. High quality sawlogs will take longer to develop, but prices will be higher. Agrifutures Australia URL: http://pfsq.net/wp-content/2008/09/timber-stumpage-values.pdf Source: Timber Stumpage Values "worth a closer look". K. R. Matthews, 2003

Other values of the timber to Agroforestry	"It is gaining popularity as a plantation timber due to its early growth, narrow crowns (the upper part of the tree including branches and leaves), relatively good form and its good quality, general use timber. It is also considered a lower risk commercial tree, particularly in a farm forestry environment, where its thick bark means it can coexist with grazing animals and it is relatively tolerant to drought and fire events". Agrifutures Australia URL: http://www.agrifutures.com.au/farm-diversity/spotted-gum/ Source: Australian Agrifutures, Spotted Gum.
Image of the living tree	Spotted Gum Image URL: https://upload.wikimedia.org/wikipedia/commons/4/4b/Spotted_gum_forest_%283242838455%29.jpg 
Image/s of the timber produced	 Spotted Gum Flooring Image URL: https://i2.wp.com/www.habitatadvocate.com.au/wp-content/uploads/2012/09/Spotted-Gum-Northern-Rivers-Timber.jpg

The hyperlinks below provide good examples of Spotted Gum uses.

- URL: https://www.daf.qld.gov.au/forestry/using-wood-and-its-benefits/wood-properties-of-timber-trees/spotted-gum
  Source: *Queensland Government, Department of Agriculture and Fisheries, Spotted Gum*.
- URL: http://www.parksidetimber.com.au/pdf/spotted-gum.pdf
  Source: *Spotted Gum – Properties and Uses, Prepared for Burnett Sawmill by Gary Hopewell, Department of Primary Industries, November 2004*
- URL: http://www.agrifutures.com.au/farm-diversity/spotted-gum/
  Source: *Agrifutures Australia, Spotted Gum*

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3. Australian Agroforestry Foundation, http://agroforestry.org.au/ Accessed 8/12/2017
4. Windbreak Image, http://article.sapub.org/image/10.5923.j.ije.20160601.02_001.gif Accessed 8/12/2017
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9. GOING BUSH 2015 EP02 Private Forestry Service QLD YOUTUBE SEGMENTS https://youtu.be/K0cMpP7iE1g Acccessed 5/12/2017
10. Native Forest Management – Private Forestry Service Queensland. https://www.youtube.com/watch?v=X5U_UyMRCZc Accessed 5/12/2017
11. Low Impact Sustainable Agriculture – Regenerating the Family Farm https://www.youtube.com/watch?v=4b26zrkwlPU&feature=youtu.be Accessed 5/12/2017

12. Dryland Salinity Image http://vro.agriculture.vic.gov.au/dpi/vro/vroimages.nsf/Images/dryland_salinity/$File/DrylandSalinity001.jpg Accessed 5/12/2017
13. Farm Forest Line, http://www.farmforestline.com.au/pages/1_why.html Accessed 24/12/2017
14. Identifying Salinity, Queensland Government Image. https://www.google.com.au/imgres?imgurl=https%3A%2F%2Fwww.qld.gov.au%2Fenvironment%2Fassets%2Fimages%2Fland%2Fsoil%2Fplants-failed-grow.jpg&imgrefurl=https%3A%2F%2Fwww.qld.gov.au%2Fenvironment%2Fland%2Fsoil%2Fsalinity%2Fidentified&docid=zFXlsMLMX7W1nM&tbnid=t3Xvimchw6v9dM%3A&vet=10ahUKEwiP-76Sqp3YAhXInZQKHe5iCSgQMwhFKAYwBg..i&w=374&h=187&bih=517&biw=889&q=salt%20soils%20creative%20commons&ved=0ahUKEwiP-76Sqp3YAhXInZQKHe5iCSgQMwhFKAYwBg&iact=mrc&uact=8 Accessed 13/12/2017
15. Soil Erosion in Britain: Updating the Record http://www.mdpi.com/agriculture/agriculture-03-00418/article_deploy/html/images/agriculture-03-00418-g008.png Accessed 26/12/2017
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17. The Conversation, Australia's plantation boom has gone bust, so let's make them carbon farms https://www.google.com.au/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwj1m_Ocr4PYAhUClZQKHdirA98QjRwIBw&url=http%3A%2F%2Ftheconversation.com%2Faustralias-plantation-boom-has-gone-bust-so-lets-make-them-carbon-farms-49754&psig=AOvVaw2NXJHn6G7AD1KLaiZyKmQ3&ust=1513130141251419 Accessed 28/12/2017
18. Bambra Agroforestry Farm. The Deep Living Project - Exploring Regenerative Living. https://www.youtube.com/watch?v=rVF5qVpkfkk Accessed 8/12/2017
19. Table 2 Major hardwood species, by National Plantation Inventory region, 2015–16. http://data.daff.gov.au/data/warehouse/aplnsd9ablf002/aplnsd9ablf201705/AustPlantationStats_2017_v.1.0.0.pdf Accessed 26/12/2017
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21. Tree Image Clipart http://laoblogger.com/image-post/62706-creative-commons-tree-clipart-6.jpg.html Accessed 26/12/2017
22. Australian Agrifutures, Spotted Gum. http://www.agrifutures.com.au/farm-diversity/spotted-gum/ Accessed 1/1/2018.
23. Timber Stumpage Values "worth a closer look". K. R. Matthews, 2003 http://pfsq.net/wp-content/2008/09/timber-stumpage-values.pdf Accessed 1/1/2018
24. Spotted Gum Image URL: https://upload.wikimedia.org/wikipedia/commons/4/4b/Spotted_gum_forest_%283242838455%29.jpg Accessed 1/1/2018.
25. Spotted Gum Flooring Image: https://i2.wp.com/www.habitatadvocate.com.au/wp-content/uploads/2012/09/Spotted-Gum-Northern-Rivers-Timber.jpg Accessed 1/1/2018.

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27. Spotted Gum – Properties and Uses, Prepared for Burnett Sawmill by Gary Hopewell, Department of Primary Industries, November 2004. http://www.parksidetimber.com.au/pdf/spotted-gum.pdf Accessed 1/1/2018.