Agroforestry - Trees at Work on the Farm

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

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

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

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Activity 1

Activity 1.1 - Trees on farms brainstorm!

As a class, collate your ideas about "Why are trees important to a farming ecosystem". Annotate your thoughts around the diagram below.

Activity 1.2 - Kahoot Forestry Quiz

Using your device, log on to https://kahoot.it/ and enter the relevant pin that will be supplied by your teacher, to test your knowledge of current forestry statistics.

Introduction to Agroforestry

Agroforestry is the introduction of trees, such as exotic commercial timber trees (such as Radiata Pine) or native timber tree species (e.g. Spotted Gum), to an existing farming system by agricultural producers. These trees form part of a larger land management plan for a property for land improvement gains, diversification of the farming system to spread farm risk, as well as economic gains for the producer upon harvesting of the trees for timber.

The Food and Agriculture Organisation of the United Nations (FAO) says of Agroforestry:

> "As world population increases, the need for more productive and sustainable use of the land becomes more urgent. According to the United Nations, more than 7 billion people populated the Earth in 2011, and this number is expected to go up to 9.3 billion by the mid-century. To meet the demand for food by 2050, production will have to increase by over 60%. These figures, coupled with current problems borne out of past and existing non-sustainable land use practices, provide the case for changing the way we manage lands and our production of agricultural and tree goods.
>
> Thanks to its multifunctional properties, agroforestry is part of the solution to addressing these issues, whether they be environmental, economic or social. Agroforestry systems include both traditional and modern land-use systems where trees are managed together with crops and/or animal production systems in agricultural settings. They are dynamic, ecologically based, natural resource management systems that diversify and sustain production in order to increase social, economic and environmental benefits for land users at all scales." FAO, Agroforestry. Oct 3, 2017.

There is a growing body of scientific literature in Australia and overseas that demonstrates the environmental, financial and social gains accruing from agroforestry adoption.

Activity 1.3 – Trees for windbreaks

A common way for producers to introduce trees on a farm is by planting a windbreak.

A windbreak is:

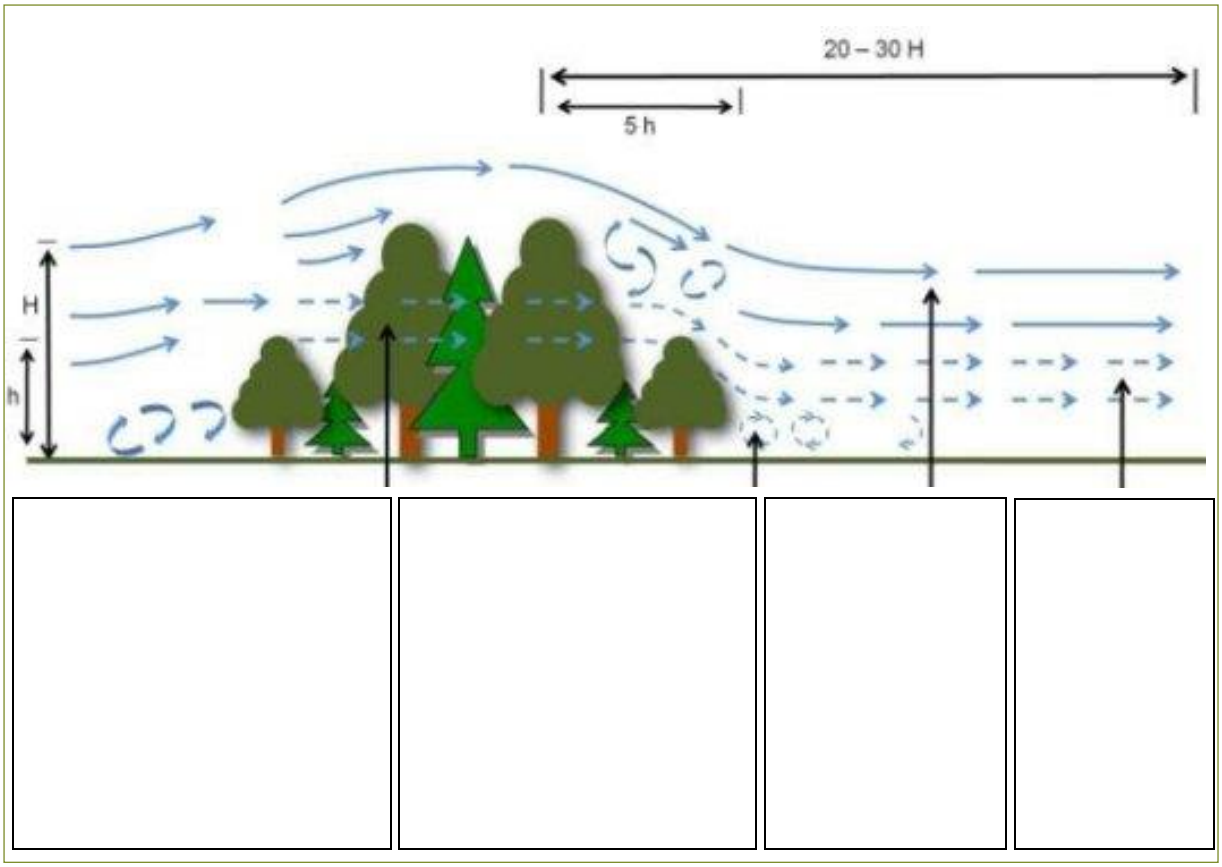
_____

_____

_____

Your teacher will provide you with features to annotate on the wind break diagram below.

Diagram 1: Illustration of a tree windbreak:



The importance of windbreaks is that they are planted for the purpose to provide protection for people and /or livestock, benefit soil and water conservation and enhance pasture / crop production. With respect to agroforestry, the species should be selected to have the future purpose of producing harvestable materials e.g. saw logs and therefore generate additional income for the producer.

Other relevant information about windbreaks:

Diagram 2: Trees planted in an orientation on a farm to reduce wind speed to protect animals and crops.

Activity 1.4 – Who owns Australia's plantation forests?

Table 1 highlights the ownership of plantations in Australia from 2004-2016. (ForestLearning has underlined the farm forestry ownership).

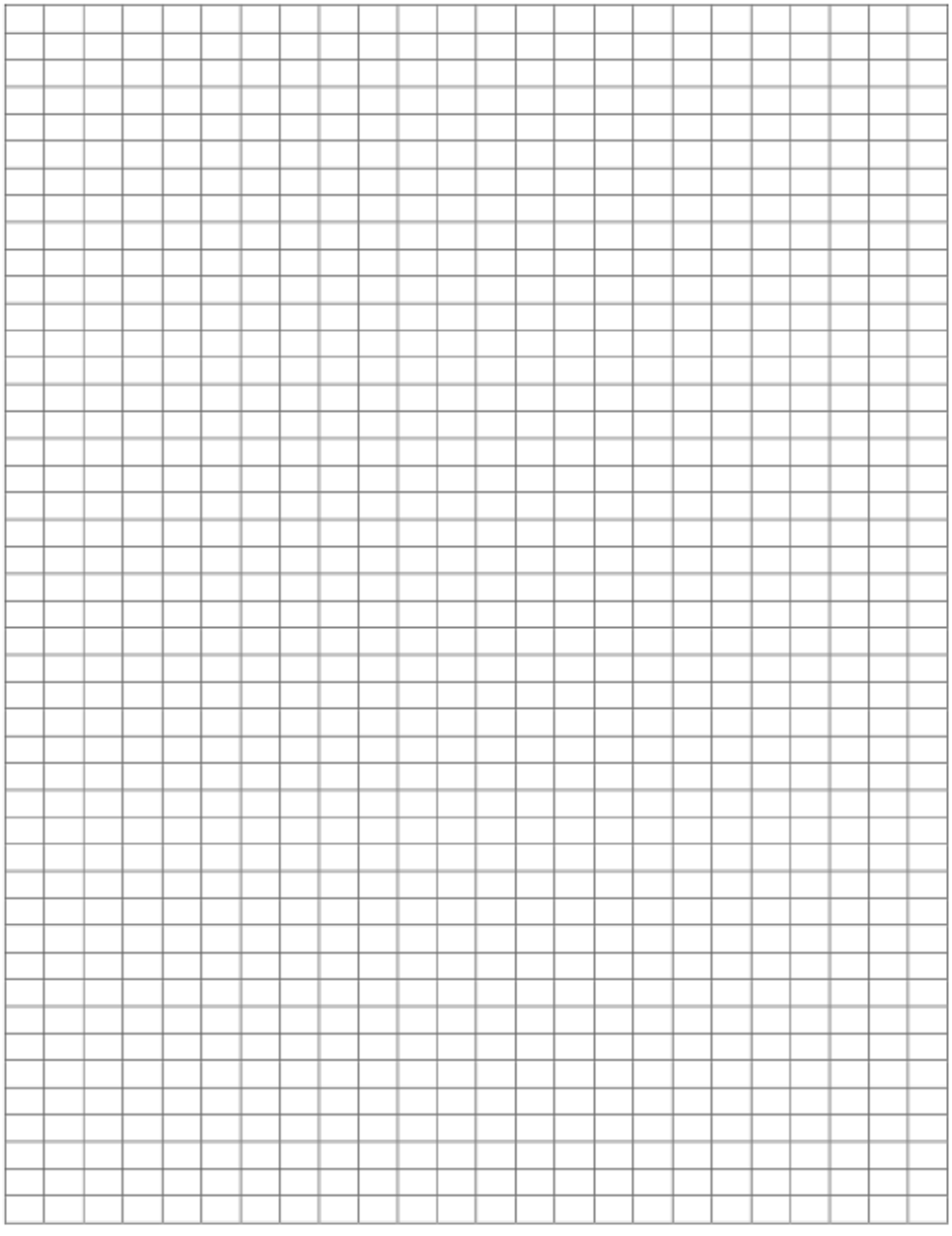
a) Graph all the data from 2004-2005, 2014-2015 and 2015-2016 for each plantation ownership percentage, using a graphing program (e.g. Excel) or by hand on the graph paper provided on page 7. Use an appropriate key to show the changes in percentage ownership over this time.
b) When you have completed your graph, answer the question provided.

Table 1 Plantation ownership, 2004–05, 2014–15 and 2015–16

Plantation owner	2004–05 (%)	2014–15 (%)	2015–16 (%)
Institutional investors	12	50	49
Timber industry companies	15	4	4
Farm foresters and other private owners	13	21	21
Managed investment schemes	26	5	5
Governments	35	21	21

Note: 2004–05 is a calendar year representing 2005; 2014–15 and 2015–16 are financial years. All columns and rows have been rounded, so percentages may not tally. Joint venture plantations are not included. Source: ABARES

Question: Describe the trend in percentage ownership of plantations from 2004-2016 and identify which owners have experienced the most significant changes over this time.



Optional Multimedia Task:

The following URL provides a good introduction to some current case studies of agroforestry in Australia. Your teacher may view this with you in class or allocate it as a homework task or set this as an extension task for your study of agroforestry.

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)*

Plantation Orientations

Planted forests can take on many different orientations (ways that the trees are planted), depending on the needs or aims of the producer.

Often producers will complete a whole farm property management plan (a process of planning, property design and management, based on natural resources and economic factors) to help increase the benefits and reduce the risk associated with implementing a new enterprise like forestry onto their farms.

Performing a whole farm property plan before planting trees also helps to ensure that the positioning of trees will be more likely to achieve the intended outcomes, the species of trees are suitable for their purpose and timber harvest outcomes and management procedures are well thought out prior to planting.

Types of planted forests can include;

1. plantations,
2. wildlife corridors,
3. alleys,
4. Windbreaks, and
5. woodlots.

Activity 1.5: Modelling plantation orientations

To complete this activity, your teacher will provide you with some short descriptions detailing the orientation of trees in different types of planted forests. You can also use the internet to research images and descriptions of each of the plantation types to help you with completing the following activity.

a) Use toothpicks and playdough (or similar materials e.g. modelling trees) to create a set of simplified models showing the orientation of trees in the different forestry types.

b) When you have completed your models, either draw a simple diagram of them or take a photograph of your models and insert the images into the table below.

c) As a class, discuss the possible roles/ purposes/ advantages of each orientation to the producer/environment.

d) After you have completed the Table 2 on page 10, draw a simple diagram of a farm on page 11 showing as many of the orientations you have modelled as possible in appropriate locations. *For example*,
   - on your pretend farm you could have a fenced windbreak and in the adjacent paddock you could draw sheep and lambs that are being protected from winter winds. (Your teacher will provide you an example of a diagram).

TABLE 2 - The orientation of trees in different types of planted forests

Orientation of trees	Diagrams or photographs of models
Plantation	
Wildlife corridor	
Alleys	
Windbreaks	
Woodlots	

Whole Farm Diagram with Multiple Forestry Orientations.

Activity 1.6: Multimedia Australian agroforestry case studies

View the three multimedia case study sources of Australian examples of Farm Forestry/ Agroforestry. Collect information regarding the advantages of incorporating or retaining timber trees on a farm. *TIP: you might like to structure your notes under the headings; economic, environmental and social advantages*.

At the conclusion of the activity, you will complete a Kahoot! quiz based on these sources.

Multimedia One: (4.58)

URL: https://www.youtube.com/watch?v=4b26zrkwIPU&feature=youtu.be

Source: *Low Impact Sustainable Agriculture – Regenerating the Family Farm.*

Multimedia Two: (6.07)

URL: https://youtu.be/K0cMpP7iE1g

Source: *Going Bush 2015 EP02 Private Forestry Service QLD, YouTube Segments.*

Multimedia Three: (7.28)

URL: https://www.youtube.com/watch?v=X5U_UyMRCZc

Source: *Native Forest Management – Private Forestry Service Queensland.*

Case Studies: Advantages of incorporating / retaining timber on a farm.

Multimedia Source One	Multimedia Source Two	Multimedia Source Three

Activity 1.7: Multimedia Kahoot! Game

Access the URL https://kahoot.it/ and enter the pin supplied by your teacher, to take part in a quiz that tests your knowledge about the information you have seen in the multimedia sources.

Activity 2

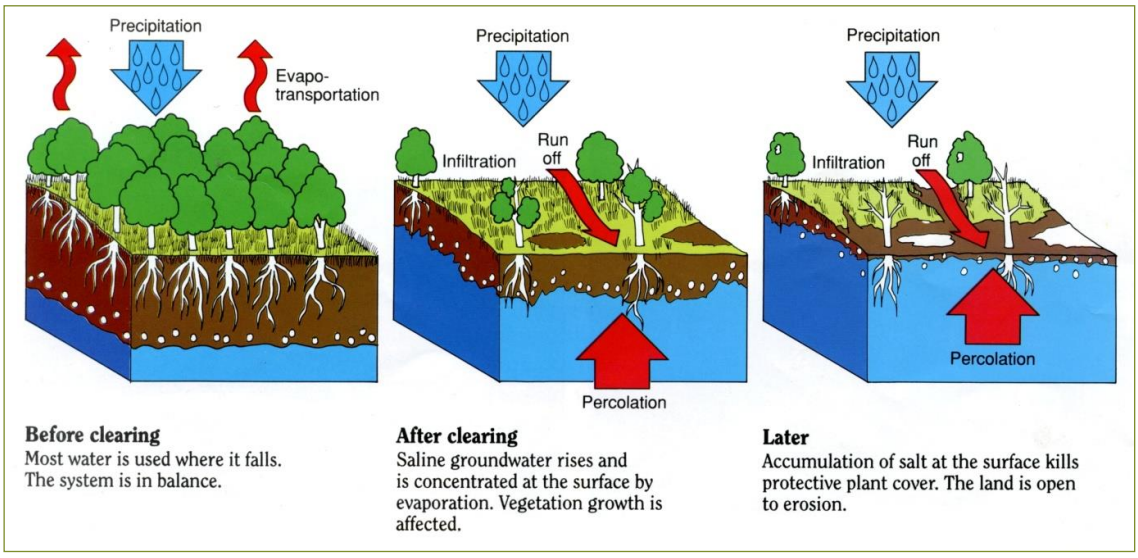
Benefits of trees on farms

Over the centuries, human impacts have caused considerable changes to the amount and type of vegetation that exists in the landscape.

From the 1800's the government mandated land clearing for producing grazing and cropping land, which consequently has led in some areas to varying levels and forms of land degradation such as erosion and salinity. Areas of marginal land that were being used beyond their sustainable capabilities have experienced reduced farm yields and declining productivity over time without intervention.

Example of Degradation – Soil Salinity

Soil salinity can be caused within an environment when trees have been cleared that previously acted as 'pumps' - intercepting water as it moved into the soil and transpiring it back into the atmosphere. This has allowed more water to recharge (enter) into the water table. This causes the water table to rise closer to the soil surface, bringing with it the dissolved salts contained within the soil.



http://vro.agriculture.vic.gov.au/dpi/vro/vroimages.nsf/Images/dryland_salinity/$File/DrylandSalinity001.jpg

Today, to create a more sustainable farming enterprise, producers may need to reassess their farming strategies and make land management decisions incorporating natural environment outcomes and a focus on long term sustainability over short term profits. Approaching the wholistic farm management of factors such as soil, water, vegetation, biodiversity and microclimate is now being scientifically proven to demonstrate improvements to pasture, and in turn animal, productivity and efficiencies of farming environments.

Agroforestry is one such strategy that assists in merging the benefits of incorporating trees on a farm with the future goal of being able to use some of the trees species as way to diversify income. In the short term the trees benefit stock yields, pasture growth, carbon sequestration, water quality and soils. In the future, these trees can also provide producers with commercial timber products such as saw logs that can be a valuable saleable product.

Activity 2.1: Photographic comparison study

The three images in the table on page 16 were taken of Yan Yan Gurt West farm (Victoria) and were photographed at the same point from 1994- 2013. The Stewart family have made considerable farming management changes over this period of time and their implementation of agroforestry into their farming has significantly changed the appearance of their landscape.

In the table below, record your observations about the visual appearance and changes in the area over this period of time and identify what management strategies you believe they might have used to achieve these changes.

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

1994 - Artificially created drainage channel on Yan Yan Gurt West Farm 	Area in 1994
1999: Same view after five years 	Same view of area in 1999
2013 – Same view after a further 14 years 	Same view of area in 2013

Activity 2.2: Brainstorming session and Poster presentation

You have now collected and observed information on the strategy of: managing agriculture by revegetating areas with the dual purpose of:

1. targeting sustainability issues, and
2. producing a commercial product.

As a class, select two students to record information on the board and discuss the following questions together (there are spaces on the following page for you to take notes).

1. Why are trees crucial to the sustainability of farms?
2. What additional benefits does the implementation of agroforestry offer to producers?
3. Should producers manage the introduction of trees by planting a monoculture of forestry species on their farm? Discuss.
4. What are some of the management strategies farmers need to consider, when implementing agroforestry successfully?
5. What are some of the issues of choosing NOT to implement a system such as this?
6. If you were a producer would you choose to incorporate agroforestry on your farm? Why or why not?
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?

Following the class discussion, your task is to create a 1-page poster on –

"Agroforestry and the benefits it can bring to a farming ecosystem".

An example of a source that will assist you in this task is provided below (you are not limited to this source).

URL: http://www.farmforestline.com.au/pages/2_why.html

Source: *Farmforest Online, Why Plant Trees? (and associated subheadings; bottom of page)*

BRAINSTORMING ACTIVITY NOTES

Activity 3

Quantifying Improvements in Agroforestry

For producers to gain a more thorough understanding of the types of returns they may encounter from the incorporation of agroforestry in their enterprise, they would need to be able to collect and analyse quantifiable/measurable data. The types of data a producer will value will differ, depending on the aims or goals of introducing trees.

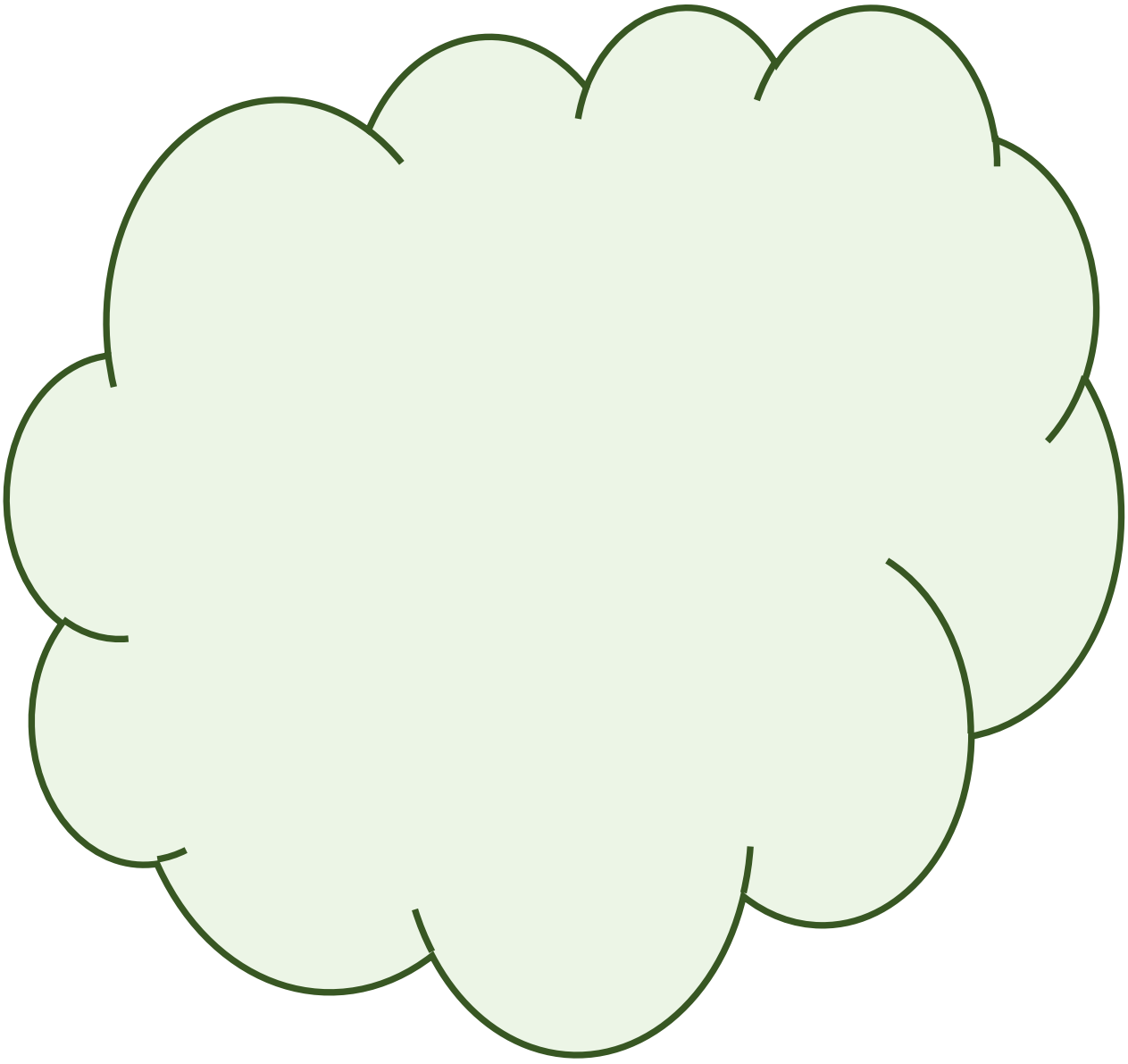
- For example, a producer experiencing issues with salinity on their property, would perhaps be most interested in planting salt tolerant varieties of trees with commercial value such as hybrids of *E. camaldulensis* x *E. globulus* and testing the soil and water salinity over time for the changing level of salt concentration.

- Alternatively, a producer who has implemented a 3-row windbreak plantation, may be more interested in recording and analysing pasture yield data over successive months and years to determine whether the protection of their pasture or crops has improved yields.

Activity 3.1: What variables would you measure?

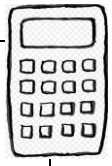
If you were in charge of designing and establishing agroforestry on your grazing farm property, consider the scientific data you might be interested in collecting over the lifespan of the trees (30+ years) to determine the "success" of your operations.

Record your ideas in the cloud below:



In the following activity, you and your class will plan a quantitative experiment that can be tested to measure the effect/s of agroforestry on a feature of the environment.

Activity 3.2: Brainstorming



As a class, collate your list of variables that could be measured beside a windbreak / wildlife corridor / plantation or native forest to quantify a measure of improvement or change. Select a variable to investigate as a class or group.

Activity 3.3: Sketch of experimental design

Design an experiment to measure the outcomes of integrating agroforestry into a farming system.

Your teacher will assist you with designing and sketching a trial plot area in a space around your school. You should annotate any relevant features of your experimental design onto the diagram before you plan your own method.

Activity 3.4: Experiment

Experiment Title

Aim

Hypothesis

Dependant Variable

Independent Variable

Control

Controlled Variables

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

Data Table

Questions

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?

2. Identify any changes to the experimental design you would make, if performing this experiment again.

3. What variables were/ would be the most difficult to control in the experiment? Why?

4. Identify any possible reasons why producers may not perform quantifiable trials on their agroforestry properties.

5. Identify reasons why it would be advantageous for producers to perform statistical trials on their property.

6. Justify the length of time you would need to conduct the experiment for to make it a valid one? (i.e. would you only perform the test once?).

Activity 4

Regionally significant tree species

Photo: Rowan Reid, Bambra

The following source material introduces the idea that species selection is a very personal management aspect of agroforestry. In Activity 4, you will be conducting your own research into a tree of interest.

Activity 4.1: Multimedia case study

View the link below and consider the message that Rowan Reid is delivering to prospective Agroforestry producers. Summarise three main points in the source material.

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

Three main points of source material.

1	
2	
3	

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

Your task is to conduct a short research investigation into a regionally significant forestry species (the ABARES tables 2 and 3 below will assist you with selecting a hardwood or softwood species that is important in your area).

Use the internet to find the following information:

Name of the tree species (common and scientific)	
Important features of tree species.	
Description of the type of timber produced.	
Uses of timber	
Economic value of the timber to Australia	

Other values of the timber to Agroforestry	
Image of the living tree	
Image/s of the timber produced	

Table 2 Major hardwood species, by National Plantation Inventory region, 2015–16

Region	Unit	Tasmanian blue gum	Shining gum	Dunn's white gum	Blackbutt / flooded gum	Spotted gum	Other eucalypts	Other species	Acacia species	Total
Western Australia	'000 ha	251.8	0.0	0.0	0.1	1.1	22.3	1.1	0.0	276.4
Northern Territory	'000 ha	0.0	0.0	0.0	0.0	0.0	0.0	14.5	31.2	45.7
Mount Lofty Ranges and Kangaroo Island (South Australia)	'000 ha	13.9	0.0	0.0	0.0	0.0	0.6	0.1	0.0	14.6
Green Triangle (South Australia/Victoria)	'000 ha	152.1	0.0	0.0	0.0	0.1	4.5	0.6	0.0	157.3
North Queensland	'000 ha	0.0	0.0	0.0	0.0	0.0	1.0	3.8	0.0	4.9
South East Queensland	'000 ha	0.0	0.0	12.1	1.4	8.6	5.9	1.7	0.1	29.8
Northern Tablelands (New South Wales)	'000 ha	0.0	1.3	0.1	0.0	0.0	0.9	0.0	0.0	2.3
North Coast (New South Wales)	'000 ha	0.1	3.1	17.4	23.4	9.9	25.0	0.6	0.0	79.6
Central Tablelands (New South Wales)	'000 ha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Southern Tablelands (New South Wales)	'000 ha	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.4
Murray Valley (New South Wales/Victoria)	'000 ha	6.0	0.5	0.0	0.0	0.0	0.6	0.1	0.0	7.3
Central Victoria	'000 ha	31.7	3.7	0.0	0.0	0.0	2.2	0.1	0.0	37.7
Central Gippsland (Victoria)	'000 ha	14.1	10.7	0.0	0.0	0.0	4.9	0.0	0.0	29.8
East Gippsland–Bombala a (Victoria/NSW)	'000 ha	0.6	6.2	0.0	0.0	0.0	0.6	1.2	0.0	8.7
Tasmania	'000 ha	19.1	208.2	0.0	0.0	0.0	0.9	5.7	0.0	233.9
Total	'000 ha	489.4	233.8	29.5	25.1	19.9	69.6	29.4	31.6	928.3
Proportion of hardwood species	%	52.7	25.2	3.2	2.7	2.1	7.5	3.2	3.4	100.0

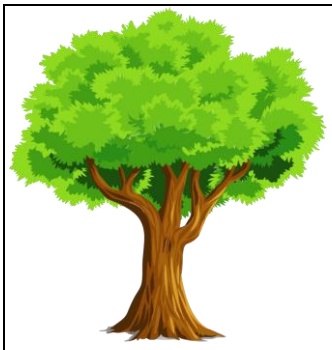
a Provisional data. Unknown plantations are not included.

Note: All columns and rows have been rounded, so totals may not tally. Source: ABARES

Table 3 Major softwood species, by National Plantation Inventory region, 2015–16

Region	Unit	Radiata pine	Southern pines	Hoop pine	Maritime pine	Other pines	Other species	Total
Western Australia	'000 ha	56.2	0.0	0.0	41.4	0.3	0.5	98.4
Northern Territory	'000 ha	0.0	0.0	0.0	0.0	1.9	0.0	1.9
Mount Lofty Ranges and Kangaroo Island (South Australia)	'000 ha	18.4	0.0	0.0	0.2	0.1	0.0	18.7
Green Triangle (South Australia/Victoria)	'000 ha	174.5	0.0	0.0	0.0	0.0	4.7	179.3
North Queensland	'000 ha	0.0	29.4	1.0	0.0	0.0	1.3	31.8
South East Queensland	'000 ha	0.8	115.8	43.5	0.0	1.0	0.7	161.8
Northern Tablelands (New South Wales)	'000 ha	13.5	0.1	0.0	0.0	1.3	0.2	15.2
North Coast (New South Wales)	'000 ha	0.3	11.0	0.6	0.0	2.5	0.4	14.8
Central Tablelands (New South Wales)	'000 ha	84.8	0.0	0.0	0.0	0.0	2.8	87.7
Southern Tablelands (New South Wales)	'000 ha	21.6	0.0	0.0	0.0	0.0	0.0	21.7
Murray Valley (New South Wales/Victoria)	'000 ha	187.1	0.0	0.0	0.2	1.8	0.5	189.7
Central Victoria	'000 ha	29.6	0.0	0.0	0.0	0.1	0.3	30.0
Central Gippsland (Victoria)	'000 ha	61.2	0.0	0.0	0.0	0.0	0.1	61.3
East Gippsland–Bombala a (Victoria/NSW)	'000 ha	48.6	0.0	0.0	0.0	0.0	0.0	48.7
Tasmania	'000 ha	75.5	0.0	0.0	0.0	0.2	0.2	75.9
Total	'000 ha	772.1	156.4	45.1	41.8	9.5	11.9	1,036.8
Proportion of softwood species	%	74.5	15.1	4.4	4.0	0.9	1.1	100.0

a Provisional data. Unknown plantations are not included.
Note: All columns and rows have been rounded, so totals may not tally. Source: ABARES



ForestLearning encourages you to source and plant your classes regionally significant tree on your school groups and send us a photo of your class doing this! This tree(s) will be a value reference for future students in your school and could be used as a longitudinal study of the benefits of agroforestry – shared with farmers in your region!

References

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