Virtual Farm

Case study workbook

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT

Department of Primary Industries

Tocal COLLEGE
RTO 91166

Virtual Farm Case Study Workbook-

ANSWER GUIDE

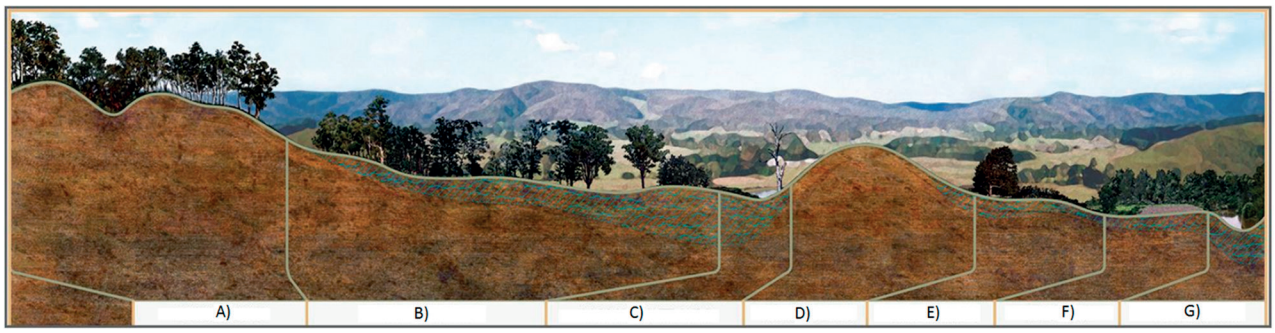
The Farm Unit- Property description

Property Name	Tocal College Farm
Location	Located in the lower Paterson Valley of the New South Wales Hunter Valley. Located mostly within the Webbers Creek sub catchment.
Managers	NSW DPI and the CB Alexander Foundation
Size (Hectares)	2200 Hectares
List the main farm enterprises and 'herd/flock size'	Beef cattle: 800-1400 head Horses: 100 head Dairy: 440 head Free range egg production: capacity 90,000 hens Sheep: 300 head Some cropping: area to cropping changes year to year

Give a brief property history (see the History of Tocal)

- Tocal has a long and proud history, which has seen it established as one of the foremost agricultural institutions in Australia.
- Tocal is on lands formerly inhabited by the Gringai clan of the Wonnarua people. The name 'Tocal' is a Koori word meaning 'plenty'.
- In 1822 James Webber took up the property as one of the first land grants in the Paterson Valley. Webber was an innovator, growing tobacco, hops, grapes, beef and dairy cattle, horses and merino sheep.
- In 1834 Webber sold Tocal to Caleb Wilson and his son, Felix. Felix built the Homestead in 1841.
- Charles Reynolds leased the property in 1844. During the next 82 years, Charles, and subsequently his widow Frances, his son Frank and grandson Darcie, ran Tocal as one of the most important Hereford, Devon and Thoroughbred studs in the country. Frank Reynolds purchased Tocal from the Wilson family in 1907.
- In 1926, Tocal was purchased from the Reynolds family by Jane Alexander. The Alexander family at Tocal consisted of Jane (known as Jean), Isabella, Robert, and Charles.
- When Charles Alexander died in 1947, he left a very large estate and a particularly detailed and complex will. His intention was that his estate be used to help orphan and destitute children by training them for agricultural careers.
- In 1963, the Presbyterian Church was awarded Alexander's Estate under a proposal designed by Edward Alan Hunt, law agent for the Church.
- In 1965, the first fifteen students were enrolled, and Sir Robert Menzies opened the CB Alexander Presbyterian Agricultural College.
- The Church managed the College until 1970 when it was transferred to the State as the CB Alexander Agricultural College, Tocal. This coincided with the passing of the CB Alexander Foundation Act, 1969.
- The Tocal property has increased through various land purchases since the College commenced - Athcourt Farm, Glendarra, Bona Vista, Dunning's Hill, Clements Farm and Numeralla. It is now 2,200 hectares.
- NSW Department of Primary Industries runs the College, assisted in many different ways by the CB Alexander Foundation, Friends of Tocal,Tocal Students Association, Tocal Alumni (encompassing the former ex-students association), Tocal Field Days Association, and the Tocal College Advisory Council.

Physical and biological resources on the farm



Topographic landscapes on Tocal

Label the topographic landscapes of Tocal in the transect A)-G)

A. Rugged hills

B. Gentle slopes

C. Lagoons and wetlands

D. Rounded hills

E. Old terraces

F. River flats

G. River and creeks

On the Tocal Property layout include the following information and a key
- Land capability classifications
- Sources of water

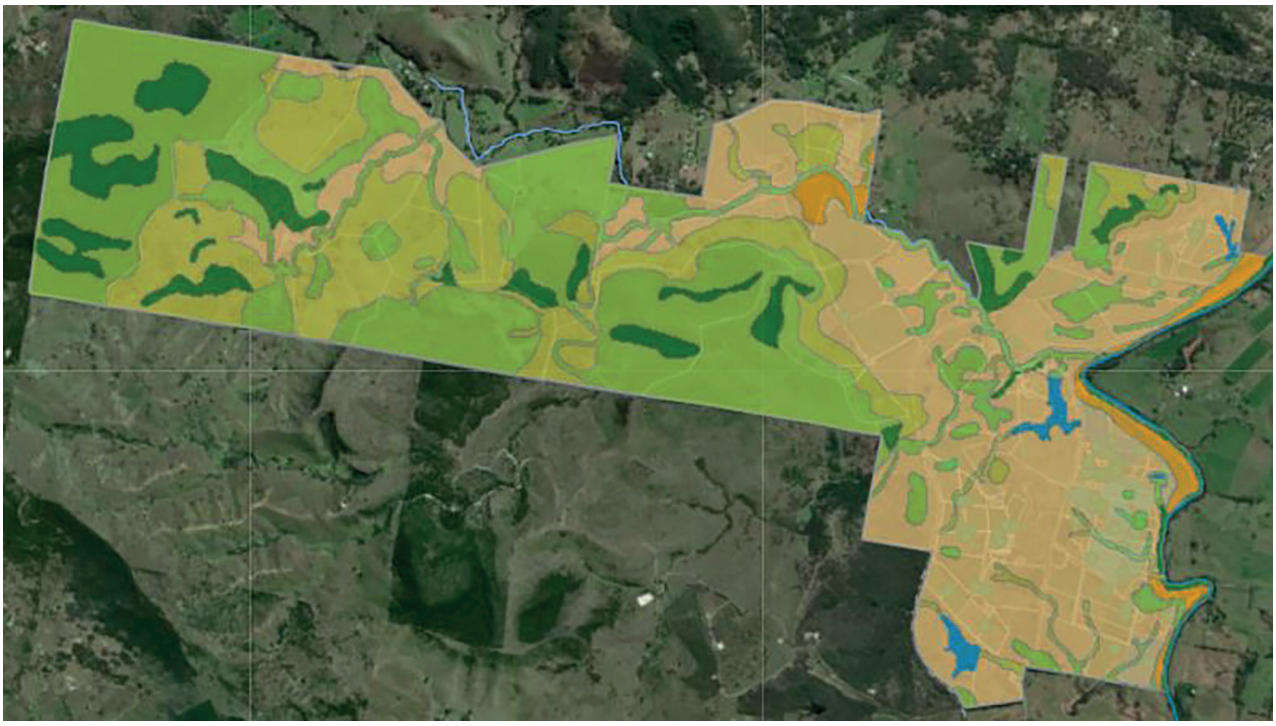


Figure 1 Land capability classifications (source: Property Overview- The Land capability on Tocal)

Figure 2 Sources of water on Tocal (source: Property Overview- Water on Tocal)

Describe the importance of the following physical features to production. In your description address how each affects the type of production on the farm and how any problems are overcome?

Soils

Soils provide a medium, nutrients, gases and water essential for plant growth. The quality of the soil and its associated physical and chemical characteristics have a direct effect on the intensity of production for all plant/grazing based enterprise systems. Problems may be overcome through the improvement of the soils physical and chemical properties e.g. addition of fertiliser, manipulation of soil pH and salinity and improvement of structure.

Water

Water quality and quantity have a direct effect on production type e.g. intensive or extensive agriculture. Water is essential for all plants and animal production. If a reliable natural water source is available agricultural production can be optimised for example through irrigation and provision of stock water in troughs. Water quality is difficult to improve on small scale- it is a catchment management focus. However management should minimise or eliminate water degradation. Quantity can be managed by optimising water collection and storage through dams, tanks and effective water usage for irrigation.

Climate

Climate has a direct effect on the intensity and types of agricultural production. Australia's agriculture is divided into farming zones (temperate, tropical, sub-tropical, arid and semi-arid). Each zone has characteristic enterprise types which can be successfully carried out dependant on major factors: temperature extremes and amount and seasonality of reliable effective rainfall. Climate on large scale cannot be altered. On small scale it can be managed through provision of irrigation or use of sheds and glass houses. Managing climatic effects involves planning enterprise type to climatic factors and strategic and tactical future planning for weather events such as drought, based on seasonal projections.

Topography

Topography has a direct effect on the intensity and types of agricultural production. Topography influences factors such as soil type distribution, soil physical and chemical properties, water movement into the soil and protection to crops and animals from weather. Topography on large scale is difficult to manipulate. To manage topography farming should be carried out according to the lands capability score.

Infrastructure

Physical infrastructure affects agricultural output and productivity. The types of infrastructure on farm will be directly linked to the types of enterprises that are carried out on the farm. Well-designed infrastructure raises farm productivity and lowers operational costs. Problems can be overcome through the maintenance, improvement or addition of farm infrastructure specifically designed for the enterprise needs.

Describe the importance of the following biological features to production. In your description address how each affects the type of production on the farm and how any problems are overcome?

Vegetation

Vegetation is essential for biodiversity to ecosystems, farming systems and supports agricultural productivity. Vegetation can have economic value, ecological value and native vegetation has cultural and heritage value. Impacts of vegetation include:

- Provision of direct economic source,
- Vegetation provides wind breaks and protection for plants and animals
- Increase water conservation
- Control and reversing resources degradation issues such as rising water tables, erosion, water quality and trees are carbon sinks assisting with carbon sequestration
- Provision of habitats for native and non-native wildlife
- Assist in pest and disease control. For example insectivores consuming pests

Pest and disease

Pests and disease have a negative economic impact on production through competition for resources as well as directly impacting plant and animal growth and development and even causing death. They affect production by reducing the marketability, quality and quantity of products. Problems associated with pest and disease can be managed through control or preventative strategies dependant on the target pest or disease.

Enterprises- Animals

Answer the following parts for at least one Tocal college enterprise

Answers will vary- Dairy enterprise as exemplar.

- Enterprise name: Tocal Dairy
- Enterprise size: 440 head/ 260 acres
- List production figures: 2.2-2.5 million litres/year

List the inputs:

- Supplementary feed
- Artificial insemination (AI) semen
- Fertiliser
- Irrigation water
- Electricity
- Fuel
- Drench, vaccines and other health and veterinary products

List the outputs:
- Milk
- Cull and cast for age (CFA) cattle

Identify the operations and processes within the enterprise:
- Breeding
- Herd management
- Pasture management
- Supplementary feeding
- Irrigation
- Milking

List the purpose of plants in this enterprise:
Plants provide vegetative cover for associated animal welfare and biodiversity issues. Pastures provide feed essential for sustaining production.

Identify methods used to control pest and disease:
- Utilisation of IPM programs for targeted pests and disease for both plant and animal systems
- Herd health is recorded including biopsies, worm testing and genetic defect testing
- Cows are routinely vaccinated and drenched as preventative strategies
- Pasture/grazing rotations are utilised

Describe methods of marketing the products from the enterprise:
Tocal Dairy is a member of Murray Goulburn Milk Cooperative (MG) which supplies milk to thye MG liquid milk processing factory in Sydney. This milk is processed and supplied to Coles and brands including the Devondale range of products. Other products include Devondale butter, spreads and cheese as well as Liddells and Table cove brands.

List 10 technologies used for production in this enterprise:
- Pastures are managed using the "Managing Pastures for Profit" system and best fit rotations (eg. CFR- Complementary Forage Rotations)
- Breeding and trialling of new pasture cultivars on site
- Milking plant- 15 aside, double up parallel herringbone system with ACR's (auto cup removers). This technology: scans infra-red NLIS tags during herd performance evaluation; and has the capability to individually identify and feed cows supplement rations throughout milking.
- Three centre pivot irrigation units.
- Soil fertility testing
- Minimum tillage sowing (eg. direct drilling). Irrigation scheduling (e.g. tensiometers)
- 90 hp New Holland tractor, balers, spray equipment, feed out equipment
- Auto drafting system
- Recording software (EasyDairy)
- AI, embryo transfer(ET) and Oestrus synchronisation programs

Outline any management practices used to improve production:
- Increase dairy production by increasing the available feed supply through extending the irrigation system.
- Maintain or reduce the overall cost of production, maximising annual economic return.
- Continually implement technology and upgrade infrastructure to increase production efficiency, sustainability and economical return.
- Utilisation of superior genetics to improve herd performance.
- Management practices and policies to treat and prevent soil, water and environmental degradation.
- Encourage ideas and resource sharing to keep abreast with new industry developments knowledge, market information, technology and skill updates.

Enterprises- Plants

Identify 5 introduced, improved pasture species at Tocal College
Oats, Ryegrass, Clover, Chicory, Plantain

Identify 5 naturalised pasture types at Tocal
Couch, Carpet grass, Paspalum, Kikuyu, Queensland Blue couch

Identify 5 native pasture species at Tocal College
Kangaroo grass, Wallaby grass, Weeping grass, Red grass, Plume grass

Identify 5 invasive weeds at Tocal
Collatai grass, Giant Parramatta grass, Chilean Needlegrass, Fireweed, Lantana

List 5 factors the farmer can change to manage pastures
- Don't overgraze pastures,
- Improve soil structure to allow for greater pasture establishment,
- Improve soil fertility to optimise pasture growth,
- Addition of water through irrigation
- Weed management to increase pasture establishment

Describe two important features of legumes in a pasture
- Legumes are important because they offer rich amounts of digestible protein, calcium and minerals.
- Legumes are important for nitrogen fixation due to symbiotic rhizobium bacterium.

Discuss the importance of a mixed pasture for grazing enterprises.
A diverse pasture mix is essential for productive grazing management systems. Livestock selectively graze more palatable and easily digestible plants, thus creating grazing pressure. A pasture ideally should contain a selection of:
- Both perennial annual pasture species
- Native, naturalised and improved pastures
- A range of monocotyledon and dicotyledonous plant

Sustainability

Define biodiversity?
Having a large variety of organisms present on an ecosystem including, plants animals and micro-organisms.

Define remnant vegetation?
Remnant vegetation or bushland is essential for biodiversity. It can include all types of native vegetation communities including forests, woodland, native grasslands and rainforest. It provides shelter for stock and crops and a habitat for native and non-native species.

List remnant vegetation types on Tocal College
Remnant rainforest, wetlands, dry sclerophyll forests and native grasslands

Outline the importance of developing vegetation corridors and where possible protecting areas of remnant vegetation.

Vegetation and remnant vegetation corridors are essential to sustaining and building biodiversity in the farm ecosystem. These areas provide:

- Shelter for stock and crops,
- Habitats and breeding grounds for miro-organisms, plant and animals
- Assist in natural pest control and biosecurity
- Reduce erosion and rising water tables

Tocal College has a strong ecological management plan to improve sustainability. It focuses on holistically managing climate, soils, water, vegetation, organisms and minimising pollution. For each area, briefly outline the goals, policy and management procedures.

Climate

Climate variability and extremes are taken into account in all operational planning for the Tocal farms. Strategic and tactical seasonal decisions are made and adjusted depending on climate data and seasonal projections.

Soils

Soils are kept healthy and fertile by appropriate management. This is achieved through practices such as:

- Maintaining ground cover at a minimum of 90%
- Fertilise to increase production from and persistence of introduced, productive species and maintain high organic matter levels.
- Use land according to its capability and use information such as soil tests to assess each paddock.
- Ensure the health of soil microbes and beneficial organisms by reducing compaction and by maintaining soil fertility, an efficient water cycle, suitable pH levels and recycling of nutrients to encourage dung beetles and earthworms.
- Ensure the soil structure remains intact by preventing overgrazing, soil compaction and inappropriate cultivation and by preventing erosion that exposes sodic subsoils. Match the water entering the soil profile with healthy plant growth so waterlogging and soil salinity problems do not emerge.
- Second policy includes identifying soil problems, mapping and treatment of these areas by conservation works or management. Existing soil problems or potential problems are treated with a rand of management strategies.

Water

- In order to protect the natural water resources:
- Water sources are protected from degradation and managed to maintain high quality water and a stable riparian zone.
- A policy of providing alternative water sources in the form of dams and troughs rather than relying on the natural water courses has been implemented.
- Irrigation water is applied efficiently: matched to plant and soil type, to ensure that crop and pasture growth is not restricted by lack of supply, and that excessive watering does not add to groundwater supplies.
- Wetlands and major waterways are protected and rehabilitated through fencing and plantings. Dam building incorporates wetland areas where applicable.
- Water problems are identified, mapped and managed to improve the condition of the water and the surrounding landscape.

Vegetation

Tree planting is carried out to achieve a balanced landscape and increase biodiversity. Existing remnant vegetation is protected and dead fallen timber is left in place.

Pasture management and grazing policies include:

- The most productive land is improved and maintained at a high level of production.
- Artificial fertiliser use is closely monitored and targeted.
- Grazing rotations are utilised.
- Native pasture areas are encouraged through strategic burning and grazing, and minimal use of fertiliser.
- Shade and shelter is provided in all grazing paddocks.
- A weed control strategy targets weeds in their location including annual control measures.

Organisms

- Native wildlife are protected to increase biodiversity.
- Where necessary, control measures are implemented for feral animals. Control campaigns are conducted according to strict guidelines, following advice and recommendations from the Local Lands Services.

Pollution

- Agricultural chemicals are used as little as possible.
- Care is taken to prevent unwanted side effects of chemical use including loss of non-target plants and soil organisms. Particular care is taken near open water and drainage lines to reduce risk to aquatic organisms.
- Any waste generated by College or agricultural activities is disposed of in an approved manner. This includes rubbish disposal, effluent disposal, disposal of dead animals and dairy waste management.

Conserving cultural heritage

- Significant sites of Aboriginal and European history are recorded and conserved.
- Significant sites of agricultural history are conserved and interpreted.

Production goals

Identify 5 production goals for Tocal College:

- Improved beef production through managing the land more effectively and using an objective recording system to verify improvement.
- Increased dairy production through increasing the available feed supply by extending the irrigation infrastructure.
- Improved capacity for horse production through improved paddock subdivision, pasture production and tree lots planted and protected.
- Sheep production maintained and wild dog attacks eliminated.
- Establish and maintain the economic goals of each enterprise.
- Maintain or reduce the overall cost of production, maximising annual economic return.
- Farm and Homestead tourism, and the Tocal Field Days be developed as self-sustaining separate commercial enterprises.
- Manage the Tocal property to support the delivery of excellence in agricultural education.

Risk Management

Identify 5 causes of risk and uncertainty in agricultural production

- Harm to the enterprise, humans, livestock and the environment.
- Climate and weather for example droughts and floods.
- Weeds pest and disease.
- Varying supply and demand.
- Market uncertainty.
- Government intervention for example legislation, tariffs, quotas, export market agreements.
- Fluctuating income.

Identify 5 ways producers can manage risk and uncertainty

- Implementation of Safe Work Method Statements (SWMS) and Workplace Health and Safety procedures (WHS).
- Implementation of animal welfare and environmental protection policies.
- Insurance for infrastructure, people, livestock, crops and income.
- Enterprise diversification- to improve cash flow.
- Utilising a range of marketing methods such as selling products to multiple markets, using future contracts, direct sales or warehouse systems to manage risk associated with market price fluctuations.
- Matching production to market specifications.

List 5 identified Workplace Health and Safety (WHS) hazards at Tocal College

- Livestock handling (eg operator and stock handling injuries especially in yards).
- Outdoor education activities and medical emergencies.
- Tourism, Field day and visitor medical emergencies and accidents.
- Steep terrain (eg vehicle and horse riding accidents caused by steep slopes).
- Riverbanks (eg slipping into water and drowning).
- Concealed objects and ruts (eg riding quad bikes in long grass).
- Flooded streams (eg driving across or horse riding).
- Accidental damage to services (eg ripping up the Telstra optic fibre cable, collision with or damage to power lines, rupture of underground pipelines).
- Zoonoses (eg Q Fever).
- Poisoning and allergic reactions (eg snakebite, use of agricultural chemicals, plant toxins).
- Cultural heritage preservation (see Cultural Heritage section).

Physical and biological resources of the farm: SOILS

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT
Department of Primary Industries

Tocal COLLEGE
RTO 91166

Acknowledgements

Lead Author:
Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors, Advisors and Co-authors:
Michelle Fifield (Education Officer Schools, NSW DPI Orange) and
Jo Hathway (Project Officer School programs, NSW DPI Tocal College).

Physical and biological resources of the farm-Soils

ANSWER GUIDE

There are 9 different soil types classified according to the Australian Soil Classification, across the Tocal College farm. Use this map to complete part a) of all following activities.

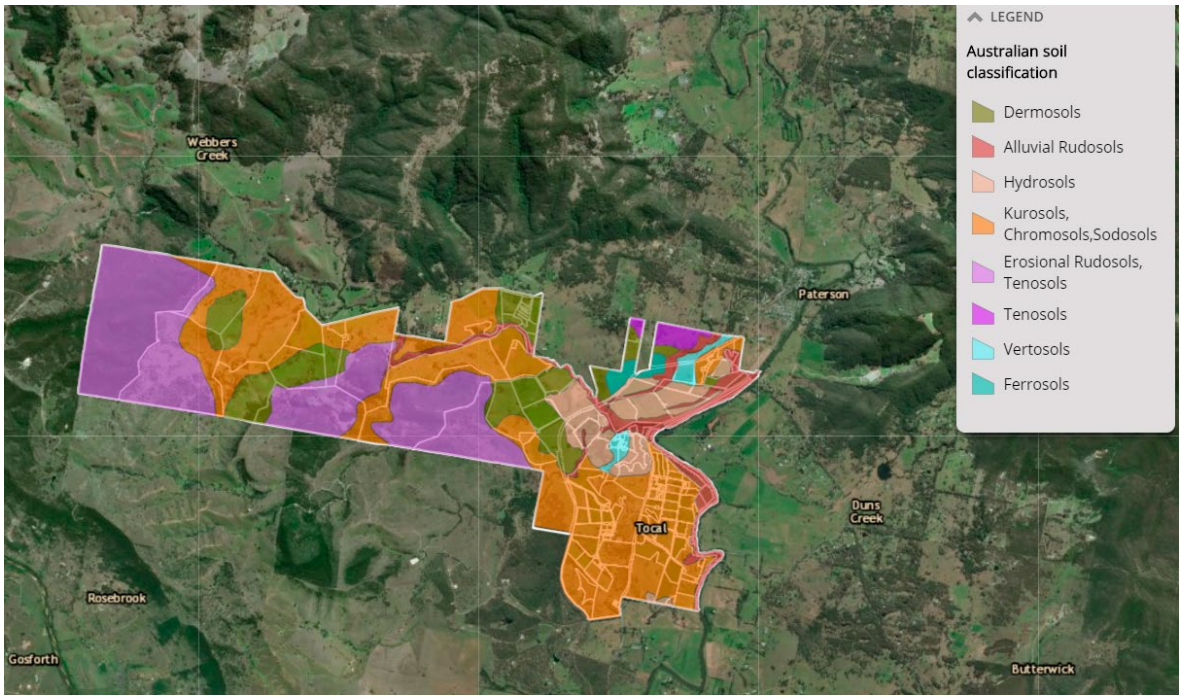


Figure 2 Tocal College Soils Map

Chromosols, Kurosols and Sodosols

1. Make a key and identify the location of Chromosols, Kurosols and Sodosol soils on the Tocal College map above (Figure 1). Label the location of "Springer 2" and "Creek paddock". *See FIGURE 1*

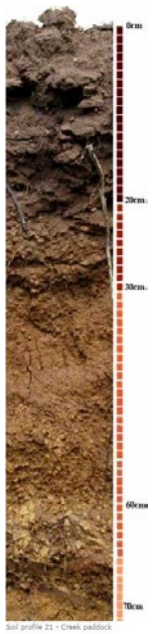
2. Define duplex soil: Duplex soils have contrasting texture between soil horizons

3. Define acidic soil: Soil with pH less than 7. The lower the pH the more acidic the soil is.

4. Identify common features of these soil types:

   » a loamy topsoil, bleached A2 horizon and medium clay subsoil which is impermeable
   » weathering and leaching
   » moderately to strongly acid (except for Sodosols)
   » crusting, hard setting and dispersion
   » poor internal drainage with waterlogging at junction of topsoil and subsoil indicated by mottling
   » difficult to till: rain won't infiltrate due to poor surface structure
   » doesn't encourage plant growth, crops show poor establishment and growth
   » Light-textured topsoil with low wet bearing strength - shouldn't be worked when they are too wet or too dry.

5. Label and describe a Kurosol-"Springer 2" and Chromosol- "Creek paddock" soil profile.

Soil Type	Soil Profile	Profile Description	Soil Type	Soil Profile	Profile Description
Kurosol "Springer 2"		• 0cm: A1 horizon. Grey-brown loam. Trace of gravel. Hard surface soil. Weak structure. Plant roots are common. Drainage is good. pH 4.9 • 9cm: A2 horizon. Light grey-brown fine sandy clay loam. Slight to moderate gravel content. Massive structure. Horizon is prone to seasonal waterlogging. pH 4.8 • 21cm: B horizon. Dark grey-brown medium clay. Slight gravel content. Gravel content increases with depth, below 45cm. Tough dense clay but has good root penetration. Plant roots are common. Drainage is fair. A centipede was found at 50cm. pH 4.3.	Chromosol "Creek paddock"		• 0cm: A1 horizon. Brown silty loam. Hard setting, lacks structure, plant roots present pH 5.5 • 20cm: A2 horizon. Brown silty loam with gravel. Plant roots present, pH 5.5 • 30cm: B horizon. Bright reddish brown silty clay loam. Limited structure, plant roots present, pH 6.0 • 60cm: B horizon. Light yellow red silty clay. Well structured, well drained, plant roots present, pH 6.5 • 70cm: C horizon. Light yellow silty clay.

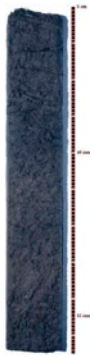
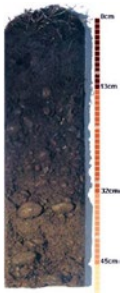
Rudosols and Tenosols

6. Make a key and identify the location of Rudosol and Tenosol soils on the Tocal College map (Figure 1). Label the location of "Windmill paddock" and "View Paddock". *See FIGURE 1*

7. Contrast the Alluvial Rudosols and Erosional Rudosols and Tenosols in the following table:

Alluvial Rudosols	Erosional Rudosols and Tenosols
• Deep soils • Hold moisture well if they are medium textured • Easy to work/till	• Shallow and stony soils on steep slopes • Limited water holding capacity- due to shallow soil

8. Label and describe a Rudosol-"Windmill paddock" and Tenosol- "View Paddock" soil profile.

Soil Type	Soil Profile	Profile Description	Soil Type	Soil Profile	Profile Description
Rudasol- "Windmill paddock"		• 0cm: Dark grey-brown loam. Abundant plant roots, well drained, pH 4.7 • 40cm: Dark grey-brown loam. Plant roots common, worm channel below 22cm, well drained, pH 5.9 • 85cm: Dark grey-brown loam. Lucerne roots at 85-90cm, well drained, pH 6.1	Tenasol- "View Paddock"		• 0cm: A horizon. Dark brown loam. Slight gravel content, plant roots common, good drainage, hard surface soil, large piece of charcoal at 6cm, pH 5.5 • 13cm: B1 horizon. Brown sandy clay loam. Heavy gravel content, plant roots common, good drainage, pH 6.2 • 32cm: B2 horizon. Yellowish brown light medium clay. Heavy gravel content, massive structure, plant roots are few, fair drainage, pH 6.1 • 45cm: C horizon. Rock

Hydrosols

9. Make a key and identify the location of Hydrosol soils on the Tocal College map (Figure 1). Label the location of "the Top flat". *See FIGURE 1*

10. Identify the features of Tocal Hydrosol soils.

» form in low-lying situations subject to permanent or seasonal water logging
» have poor site and internal drainage indicated by rusty mottling in subsoil
» have a high organic matter content
» heavy clay soils, hard to cultivate.

11. Label and describe a Hydrosol-"the Top flat" soil profile.

Soil Type	Soil Profile	Profile Description
Hydrosol-"the Top flat"		• 0cm: A horizon. Dark grey-brown silty light clay. Plant roots common, drainage only fair, note crumbly structure with pore spaces, pH 4.9 • 29cm: B horizon. Grey-brown medium clay. Plant roots common, pH 6.7 • 44cm: B2 horizon. Dark yellowish grey heavy clay which is poorly drained. Plant roots common to 70cm, weak rusty mottles, Fe/Mn concretions, especially at 65 to 75cm, slight dispersion of clay, pH 6.7

Black Vertosols

12. Make a key and identify the location of Black Vertosol soils on the Tocal College map (Figure 1) Label the location of "Phillips paddock". *See FIGURE 1*

13. Identify the features of black Vertosol soils.

» Cracking clay soils
» Uniform, fine textured soils, developed from the slow settling of suspended clays
» Vertosols have more than 35% clay in all horizons
» Heavy soils that are difficult to work and so they are more suited to grazing than cropping.

14. Label and describe a Vertosol-"Phillips paddock" soil profile.

Soil Type	Soil Profile	Profile Description
Vertosol-"Phillips paddock"		• 0cm: A horizon. Dark grey-brown clay loam over a light clay. Abundant plant roots, well drained, evidence of soil fauna. This horizon is porous. • 28cm: B horizon. Dark yellowish-brown medium clay. Cracks readily when dry, plant roots common, drainage fair • 66cm: B/C horizon. Dark yellowish brown and reddish brown heavy clay. Slickensides obvious below 70cm • A trace of charcoal was found at 85cm (burnt plant root from a hot fire?), many plant roots, drainage poor

Dermosols

15. Make a key and identify the location of Dermosol soils on the Tocal College map (Figure 1) Label the location of "Calving paddock". *See FIGURE 1*

16. Identify the features of Dermosol soils.

    » moderately well to imperfectly drained
    » gradational profiles with structured B2 horizon
    » deep humic topsoil which is acid
    » weakly weathered and weakly leached - pH increases with depth.

17. Label and describe a Dermosol-" Calving paddock" soil profile.

Soil Type	Soil Profile	Profile Description
Dermosol- "Calving paddock"		• 0cm: A horizon. Very dark grey-brown clay loam, with fine crumb structure. Surface soil hard. Plant roots abundant. Drainage good. pH 4.5 • 12cm: B1 horizon. Very dark grey to black light medium clay. Slight amounts of angular gravel. Large angular fragments of volcanic rock. Cultivation has mixed the colluvial gravel with the soil. Structure is fine crumb. Drainage good. Plant roots common. Note large horizontal tree root at 21 cm. • 25cm: B2 horizon. Very dark grey to black heavy clay. Fine crumb structure. Drainage fair. Plant roots common. Burnt soil found at 30cm. pH 5.8 • 49cm: B2/C horizon. Dark yellow-brown and very dark grey heavy clay. Clay cracks when dry. Angular blocky structure. Plant roots common. Drainage fair. pH 6.6. • 75cm: C horizon. Very dark brown sandy clay with yellow fragments of deeply weathered rock. Note lime concretions up to 10mm diameter. Massive structure. 8mm horizontal tree root at 70cm. Few if any other plant roots. pH7.0.

Red ferrosols

18. Make a key and identify the location of Red Ferrosol soils on the Tocal College map (Figure 1) Label the location of "Bowkers paddock". *See FIGURE 1*

19. Identify the features of Red Ferrosol soils.

- Derived from weathered basalt
- Good structured soil, excellent moisture penetration, WHC and good drainage.
- High fertility- requires no addition of fertilisers

20. Label and describe a Red Ferrosol -"Bowkers paddock" soil profile.

Soil Type	Soil Profile	Profile Description
Red Ferrosol- "Bowkers paddock"		• 0cm: A horizon Dark brown light clay with a trace of gravel. Hard surface soil, topsoil has fine crumb structure, roots common, drainage good, pH 4.7 • 20cm: B horizon Dark reddish brown light medium clay with some gravel. Band of strongly weathered rock at 31-48cm, note some roots but only to 50cm, pH 6.5 • 80cm: C horizon. A dark reddish brown light clay with many yellow brown rock fragments. No plant roots, drainage good, pH 6.9

Summary Questions

1. Explain why soils that developed on steep slopes are more eroded than soils developed on gentler slopes.

   Topography has a significant impact on soil formation. Due to gravitational factors topography determines water runoff. For soil to form, the parent material needs to lie relatively undisturbed so soil horizon processes can proceed. Water moving across the surface strips parent material away impeding soil development. Water erosion is more effective on steeper, un-vegetated slopes, therefore on steeper slopes soils are more eroded.

2. Soils developed in flat lying regions typically have more topsoil (A horizon) than those developed in sloping regions.

3. Layers that appear within a soil are referred to as soil horizons.

4. A vertical section exposing a soil represents its soil profile.

5. Identify which horizon is characterised by organic debris in various stages of decay? O horizon

6. Identify which horizon is characterised by humus mixed with mineral and rock fragments? The A horizon is composed of a mixture of organic matter, rock fragments, and minerals. It is typically darker in colour than the underlying horizons, and is coarser due to eluviation of finer grained material. It is sometimes referred to as the zone of leaching.

7. Identify which horizon is characterised by the accumulation of clay-sized particles? B horizon which is sometimes referred to as the zone of accumulation.

8. Identify which horizon is characterized by recognizable pieces of parent material? C horizon

9. List essential elemental nutrients do plants and animals extract from the soil and atmosphere? C, H, N, O, P, K, Ca, Mg, and S

10. List the macro elements that Australian soils are characteristically low in? Nitrogen Potassium and Phosphorous

11. Explain how can soil pH impact production?

    Soil pH is a measure of how acidic or alkaline a soil is. Plants have individual pH range tolerances for optimal production. For most plants, soil pH should be in the range 6.0 to 7.0. If it is more alkaline, the availability of some nutrients, for example, zinc; becomes limiting. If it is more acidic, soluble aluminium may be released into the soil solution. Very high pH values usually indicate the presence of sodium bicarbonate and carbonate salts.

    The use of fertilisers such as ammonium sulphate, as well as organic matter conservation, tends to acidify a soil, while lime ($CaCO_3$) is used to increase pH.

12. A) Contrast good and poor soil structure.

    B) Discuss how soil structure can be managed to improve production? Use the scaffold if required.

    Answers will vary.

    a) Soil structure refers to the arrangement of sand, silt, clay particles and the spaces between them. Individual soil particles usually stick together to form aggregates (similar to a clod), leaving air spaces or pores between the aggregates. Soil aggregates are stuck together by cementing agents', such as clay, organic matter and hydrous oxides of iron and aluminium. It is rare for soil particles to exist as single units in the soil (except in sands). Therefore, the soil generally consists of many distinct soil aggregates. Aggregate size and shape, and the air spaces between, largely determine structure.

Structure can be rated as good or poor from a plant-growth point of view. Poor structure does not allow good movement of water and air, and hence plant growth is poor. Soil that consists of large blocks with few pores or air spaces in the soil is said to have a 'massive' structure and has a high bulk density. This condition is poor for plant growth.

A well-structured soil, as well as having many small aggregates, has ample space within and between the aggregates to allow good penetration of water, air and plant roots (transmission pores). It also has adequate small pores to store water for use by plants (water storage pores).

b) Soil structure directly impacts agricultural production. Poorly structured soils cause low production in plants. Poor structure can be a result of natural process or from human management. It is an issue which can be reversed through management.

Tilling soils that are too wet, or compacting soils with heavy equipment can break down the natural structural units.

Addition of gypsum, makes soils particles flocculate (cement together), thus improving structure. Ca displaces Na in sodic soils.

Increase levels of organic matter (OM) in the soil. Organic matter in soils consists of all living and dead plant and animal matter. Organic matter includes seeds, leaves, roots, earthworms and manure, as well as bacteria, fungi and humus. Soil structure is highly dependent on organic matter content. Increasing organic matter content directly correlates with improving soil structure. In clay, high levels of organic matter force the tightly packed clay particles apart; improving drainage and the soil is easier for plant roots to penetrate. In sand, it lodges in the large pore spaces and acts as a sponge, slowing drainage so the soil retains water longer. Organic matter tends to be concentrated in the upper part of the topsoil, since this is where plant production takes place. Decayed plant/animal material becomes a dark material called humus. Other advantages of increasing organic matter content in the soil is the increased provision of nutrients for plants and micro-organisms as it decomposes; increasing water retention capacity of soil, improved drainage and increased CEC.

Other management methods to increase OM content to improve soil structure include: implementing crop rotations -using crop and long pasture phases, retaining crop residues, minimise cultivation and use sustainable approaches where possible (e.g. no till, direct drill, conservation tillage) , cover copping, residue mulching, never having a bare fallow, stubble retention, integrated nutrient management.

SYSTEMS
agriculture

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT
Department of Primary Industries

Tocal COLLEGE
RTO 91166

Acknowledgements

Lead Author:
Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors, Advisors and Co-authors:
Michelle Fifield (Education Officer Schools, NSW DPI Orange) and
Jo Hathway (Project Officer School programs, NSW DPI Tocal College).

Systems Agriculture Worksheet- ANSWER GUIDE

The following section requires students to utilise the Tocal College resources in addition to this worksheet, to complete the following activities.

- Tocal Property and Farms
- ESRI Story Maps

1. Define systems approach

   "A systems approach is a holistic way of addressing a complex and interactive set of problems within a set of boundary conditions. It aims to identify, quantify, and integrate all of the factors and processes that shape and constrain farming systems. By doing so, it helps identify researchable issues, clarify relations, and generate testable hypotheses for research and development. 'Systems thinking' examines every aspect of the climatic, biological, political and financial context in which farmers and pastoralists operate, identifying the most suitable solutions to sustainably enhance productivity and reduce risk."

2. List the main enterprises and subsystems on Tocal College.

   Beef, dairy, egg production, stock horses, sheep, resources, humans/management

3. How is it possible that farmer systems are subsystems of much larger systems?

   Farm systems are part of agricultural regions, rural industries and national economies. They can also be perceived as part of a global agricultural/trading and economic system. The identification of the boundary limits the size of the system being investigated.

4. What advantages are there of making a model to represent a farm system?

   - Simplify complex structures and processes.
   - Used for communication or clarification.
   - Can be altered to communicate specific information.
   - Allow analysis of systems from multiple perspectives.
   - Identify cause and effects.
   - Improve system understanding through visual analysis.
   - Allow for identification of errors quickly.
   - Allows for exploration of alternatives.
   - Improve impact analysis and identification of potential consequences due to change.
   - Different model types show different depth of data.

5. List the inputs.

   Answers will vary- Beef as exemplar

   - Brangus bulls
   - Angus bulls

- Charolais bulls
- Seed for pasture improvement
- Fertiliser
- Herbicide
- Drench/vaccine
- Fencing materials
- Mineral supplements
- AI semen

6. List the outputs.

   Answers will vary- Beef as exemplar

   - Yearlings
   - Cast for age (CFA) and cull cows (e.g. empty cows)
   - Commercial bulls
   - Stud bulls

7. List the position of the systems boundary.

   Answers will vary- Beef as exemplar

   - Boundary is physical fence line encompassing 1790Ha of land.

8. What stimuli, outside the boundary are likely to influence the enterprise?

   Answers will vary- Beef as exemplar

   - Stimuli would include: climate, local environment, operational and educational requirements of Tocal College, government policy and economic conditions.

9. What sort of feedback information should the manager monitor for this enterprise?

   Answers will vary- Beef as exemplar

   - Production performance- birthweight, weaning age, calving percentage, growth rate, meat quality and yield, price/kg (weaners), price/bull (stud), pedigrees for stud animals sold.
   - Sustainability- could include water usage, fertiliser rate, chemical usage, feed wastage, soil degradation issues.

10. Create a black box model for your chosen enterprise.

    Include:

    - All inputs
    - Boundary
    - Enterprise type within boundary
    - All outputs

11. Create a dynamic model for your chosen enterprise.

    Include:

    - All inputs
    - Boundary
    - All subsystems
    - Use arrows to show connections
    - Processes and relationships between inputs, outputs and subsystems identified and labelled.
    - All outputs

Measuring agricultural performance and finance

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT
Department of Primary Industries

Tocal COLLEGE
RTO 91166

Acknowledgements

Lead Author:
Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors, Advisors and Co-authors:
Michelle Fifield (Education Officer Schools, NSW DPI Orange) and
Jo Hathway (Project Officer School programs, NSW DPI Tocal College).

Measuring agricultural performance and finance- SUGGESTED ANSWERS

1. Define partial budget.

A quick method used for considering change which requires additional capital investment. The budget identifies additional annual income and costs associated with the change. Calculation of a percentage return on the additional capital required to implement the change gives an indication if further investigation is warranted.

2. Define whole farm budget.

Generally includes a summary of farm assets and liabilities. It estimates various profit measures by taking into account total gross margins for each of the enterprises considered, as well as the farm overhead costs (such as rates, interest payments, depreciation, administration, employed labour, insurance). It also considers an allowance for family labour. Profitability from different enterprise mixes can be compared on a whole farm basis using this type of budget.

3. Define development budget.

This is a cash flow budget over a longer period of time. A development budget is used for projects that take a number of years to reach full income earning potential e.g. a horticultural crop or a project that requires a large initial amount of capital. Discounting of future income and costs is often used to compare projects.

4. Define cash flow budget.

Estimates the cash balance in an account over a period of time. It is usually completed on a monthly basis for 12 months in advance. This form of budget is very useful in anticipating likely cash shortages or surpluses.

5. Contrast differences between cash flow budgets and profit and loss statements.

Profit and loss statements include depreciation and accrued value of inventory. Cash flow budgets include personal and off farm income, personal expenses, income tax and capital sales and purchases.

6. Which financial measurement is a good financial indicator of the risk level of a property and identify the benchmark.

Equity% or Net worth

Benchmark: >70%

7. Return to capital (%)

   a) What is the return to capital% for this farm? (Income- cost) / total assets x100%= 8%

   b) Rate the farms return to capital? Strong > 6

8. Write the equation to determine a gross margin.

$$\text{Gross Margin (C)} = \text{Total income (A)} - \text{Total variable costs (B)}$$

9. Define variable costs.

Variable costs are specific to a particular enterprise and do not include fixed or overhead costs for the whole farm.

10. Does a gross margin reflect profit? Explain.

A gross margin does not reflect profit because it does not include fixed or overhead costs such as depreciation, interest payments, rates and permanent labour, which have to be met regardless of enterprise size.

11. List the units a gross margin are determined to.

Per hectare; per mega litre of water with an irrigation enterprise; per animal eg. per breeding cow/ewe; or per steer/wether; per DSE

12. Describe what a gross margin enables a producer to compare?

It enables you to directly compare the relative profitability of similar enterprises, and consequently provides a starting point to deciding or altering the farms overall enterprise mix.

Gross margins can be used to analyse actual enterprise performance. Comparing your own gross margins with standards for the district is a worthwhile exercise. Major differences may be explained by particular farm characteristics, but may also indicate areas of potential improvement.

13. What are the limitations of a gross margin?

- It is a projection of price expectations in the near future, rather than a statement of the recent past. It is extremely difficult to accurately predict future prices, growth rates and feeding costs, to name a few of the variables
- Overhead costs are excluded
- Do not consider different land, labour and equipment requirements by different enterprises
- Do not reflect future profit

14. Variable costs activity

Vet costs for heifer AI program	~~Electricity~~
NLIS tags	~~Depreciation on machinery and structures~~
~~Telephone~~	Contract harvesting
Hay for cattle	Molasses licks for calving cows
Replacement heifers	~~Stationery~~
~~Wheat cartage grading and packing~~	Cartage for heifers
~~Labour~~	~~Crop insurance~~
Copper capsules for weaner cattle	Bovine 5-in-1 Vaccination
Replacement bulls	~~Herbicides~~
~~Magnesium blocks for lambing ewes~~	~~Insurance~~
~~Fuel~~	~~Workers Compensation~~
~~Livestock pellets~~	~~Replacement ewes~~
~~Rates~~	

15. A list of entries being compiled for a gross margin for the Tocal dairy production enterprise is shown.

a) Identify variable costs relevant for the gross margin. Correct values highlighted

b) Calculate the total variable costs

Identify Variable Costs	Value
AI semen	$12000
Day old chicks	$5000
Cattle Sales	$76,520
Supplementary feed- dairy grain $300/t @ 100t	$30,000
Supplementary feed-dairy hay $200/t @ 100t	$20,000
Freight for feed $50/t @ 200	$10,000
Freight for milk	$18,000
Tractor and vehicle maintenance	$8,000
Electricity/quarter	$22,000
Dairy pasture costs	$110,000
Total Variable Costs	**$200,000**

16. Complete the following Beef Cattle Gross Margin (Adapted from NSW DPI, 2017)

BEEF CATTLE GROSS MARGIN BUDGET				
Enterprise: Feeder steers				
Enterprise Unit: 100 cows				
Pasture: Native pasture				
INCOME:				
	Description	$/Head		Total
	38 steers 18 months @	$1,518		$57,684
	4 steers 20 months @	$1,518		$6,072
	22 heifers 9 months @	$756		$16,632
	1 CFA Bull @	$1,665		$1,665
	7 CFA cows @	$1,163		$8,138
	11 Other culls @	$1,163		$12,793
			(A) Total Income:	$102,984
VARIABLE COSTS:				
	Replacements 1 Bull @	$7,000 /hd		$7,000
	Livestock and vet costs:			
	Pestigard (pestivirus vaccinations) @164 head	$4.50/dose (2x)		$1,476
	Leptospirosis vaccinations (7 in 1 instead of 5 in 1) @180 head	$2.00/dose (1x)		$360
	Piliguard (pinkeye vaccinations (excluding early weaned calves) 130	$4.60/dose (1x)		$598
	Fertility tests for bulls	$250/2 bulls		$500
	Ear tags @ 40	$2.00/head		$80
	Fodder crops / hay / grain / silage	$0		
	Drought feeding costs.	$0		
	Pasture maintenence 424 Ha native pasture	$0		
	Livestock selling cost (see selling cost note below**)	$6,742		$6,742
			(B) Total Variable Costs:	$16,756
			(C) Gross Margin (A-B)	$86,128
			Gross Margin/COW	$861.28
			GROSS MARGIN/DSE*	$58.20
			GROSS MARGIN/HA	$203.13
Additional Information				
**(Commission 4%, yard dues $3.00/hd, MLA levy $5/hd, average freight cost to saleyards $15.00/hd; NLIS tags @ $3.60 for all sale cattle)				
DSE rating per cow, around 14.8. (DSE calculated with C/DSE/ # Cows) This is an average figure and will vary during the year.				
Gross margin per DSE is a comparison of the best returns that can be achieved per unit of energy requirement and so allows comparison with other animal enterprises.				

17. Complete the following Wheat Gross Margin (Adapted from Farm Gross Margin and Enterprise Planning Guide 2017.

WHEAT GROSS MARGIN BUDGET					
Enterprise: Wheat					
Enterprise Unit: 500 acres					
Grade/ Variety : APW Medium/ Sunstate					
INCOME:					
	Description		**$/Ha**		**Total**
	2.7 tonnes/Ha		$225		$122 923.40
				(A) Total Income:	**$122 923.40**
VARIABLE COSTS:					
	Seed		Rate (kg/ha)		
	Seed ($0.22/kg) @		80		$3,561.24
	Seed Treatment(1) ($0.04 /kg) @		80		$647.50
	Levies				
	GRDC Levies 1.0% Gross or Total Income (A)				$1,229.24
	Fertiliser (Bulk)				
	18:20:0 $550 /tonne @		60		$6,677.32
	Urea $440 /tonne @		80		$7,122.44
	Chemicals-Herbicides				
	Glyphosate 540 $6.00 /litre @		1.2		$1,456.87
	Topik (3) $37.70 /litre @		0.085		$648.41
	Affinity® $125.00 /litre @		0.1		$2,529.29
	MCPA Amine (750g/L) 8.95 /litre @		0.33		$597.62
	Operations				
	Fuel & Oil		$12.13		$2,454.42
	Repairs & Maintenance		$17.60		$3,561.24
	Freight				
	Grain (t) @$20/t		2.7t		$54.00
	Fertiliser (t) @$20/t		1.6t		$32.00
	Contract Work				
	Aerial spraying @ $14.00/Ha				$2,832.80
	Urea spreading @ $8.50/Ha				$1,719.92
				(B) Total Variable Costs:	**$35,124.31**
				(C) Gross Margin (A-B)	**$87,799**
				Gross Margin/Ha	**$433.91**
Additional Information					
1HA = 2.47 acre					

Calendar of Operations

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT
Department of Primary Industries

Tocal COLLEGE
RTO 91166

Acknowledgements

Lead Author:
Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors, Advisors and Co-authors:
Michelle Fifield (Education Officer Schools, NSW DPI Orange) and
Jo Hathway (Project Officer School programs, NSW DPI Tocal College).

Calendar of Operations – SUGGESTED ANSWERS

1. What do the numbers 1-4 from Table 2 indicate?

   Four management groups within the beef enterprise- cows, calves/weaners, yearlings, steers

2. Identify quieter periods that occur in the beef operation

   November- March (summer) and May-July (Autumn- early winter)

3. Identify other enterprises which could be farmed in conjunction with the beef enterprise. Explain why they'd be appropriate in terms of resource management.

   In areas with winter dominant rainfall, suitable soils and climate; a cereal cropping program could be established. It would complement beef production, as there are fewer husbandry operations occurring during key periods for a cropping enterprise that would allow for management of resources labour between both. e.g. Soil prep Feb-Mar; sowing- early winter; harvest Nov-Dec.

4. Select 8 operations from Table 2 to complete the following table.

Answers will vary. Suggested answers provided

Husbandry practice	Description of operation and effect on production	Identify and explain timing of operation
Heifer selection	Selection of heifers to be retained for breeding. Superior females are selected using production criteria e.g. EMA, weight/age, and genetics. Heifers are integrated into breeding program and replace non-productive females.	Sep Carried out before joining to allow for culling and sale of undesirable females to the breeding program
Joining	Mating, to produce offspring. Offspring essential for production.	Oct-Dec Timed with Spring flush of feed- to meet cows extra nutritional lactation requirement
Calving	Giving birth	Jul-Sep Occurs nine months after joining- 9 month gestation. Timed for Spring calving
Castration / Marking	Removal of the testes from male calves. Increases carcass marketability.	Oct Calves up to 3 months old- ideal for marking according to animal welfare considerations
Weaning	Removal of calves from their mothers so that they can no longer drink milk. Allows greater management to meet cow and calf nutritional requirements for production purpose.	Apr Calves 6-9 months old. Claves nutritional needs met be Autumn flush of feed. Gives cows opportunity to gain condition in preparation for upcoming calving
Vaccination	Injection (usually subcutaneous) given to prevent diseases such as blackleg, tetanus, enterotoxaemia, black disease and malignant oedema (5 in 1) if prevention against two strains of Leptospirosis is included then it is called 7in 1. Incurs production costs however, increases production efficacy by reducing health management issues.	First Oct; second vaccination Nov. Two stages with yearly booster Apr. Preferred vaccination program to provide immunity with second vaccination boosting immunity and yearly boosters thereafter. Occurs in calves <3 months old to provide immunity to selected diseases; also to not have any incursions to chemical withholding period before sale
Drenching	Administering an oral medication to kill internal parasites e.g. fluke. External parasite control may be achieved by spraying or using pour-on or backline treatments. The use of these depends on the climate, season and type of enterprise. External parasites that affect cattle include flies, lice and ticks. Incurs production costs however, increases production efficacy by reducing health management issues	First Apr; second Aug To target fluke lifecycle and environmental influences. Fluke is most prevalent in Winter and Spring; therefore drench Autumn preventative and Spring booster
Supplementary feed	Provision of supplements, grain, forage, hay, minerals etc. Management practice to meet animals' nutritional requirements dependant on their production need. e.g. steers requirement for finishing, calf for growth and development, cow for lactation and or maintenance	Aug-Sep- cows Apr- steers Cows- to meet lactation nutritional requirements Steers- to finish them for sale
Pregnancy testing	Two methods- rectal palpation or scanning using an ultrasound. Procedure increases reproductive efficiency and enterprise productivity though identification of non-pregnant cows.	Feb- normally carried out 8-10 weeks after the end of joining Allows for development of foetus to stage that identification can be achieved. Empty cows separated in preparation for sale

5. Follow the link to the '**Tocal Property and Farms**' booklet. In the beef enterprise section, find the subsection on 'Herd Management'. Use this information to create a tabular calendar of operations below. In your calendar of operations for Tocal Beef, include:

   » The two calving periods
   » Cow joining
   » Heifer joining
   » Weaning dates

Month	Autumn calvers	Spring calvers
January		
February		
March	Calving Cows- 9 weeks Heifers- 7 weeks	
April		
May		Weaning Spring calves
June	Joining Cows- 9 weeks Heifers- 7 weeks	
July		
August		Calving Cows- 9 weeks Heifers- 7 weeks
September		
October		
November		Joining Cows- 9 weeks Heifers- 7 weeks
December	Weaning Autumn calves	

6. Identify the benefits of having split Autumn and Spring calving periods at Tocal College?

   - *Management of risk, for example seasonal influence on market and pasture production*
   - *Allows for greater cash flow (diversification)*

Methods of agricultural record keeping

ANSWER GUIDE

connect • grow • learn
DPI in SCHOOLS

NSW GOVERNMENT
Department of Primary Industries

Tocal COLLEGE
RTO 91166

Acknowledgements

Lead Author:
Meg Dunford (Project Officer School programs, NSW DPI Orange).

Editors, Advisors and Co-authors:
Michelle Fifield (Education Officer Schools, NSW DPI Orange) and
Jo Hathway (Project Officer School programs, NSW DPI Tocal College).

Methods of Agricultural record keeping worksheet- ANSWER GUIDE

1. Create a table contrasting advantages and disadvantages of farm records

Positive	Negative
Allow for compliance with the business' legal obligations of keeping specific mandatory records	Time consuming
Maintain a permanent record of the farm business	Can be costly to set up in hardware and software- electronic
Allow for analysis of the business	Can require skills in ITC to utilise and operate software or technology effectively
Accurate and detailed records support all aspects of the management cycle	Hand written records may be incomplete and hard to follow
Allow for the capacity to set realistic goals for future planning and develop sound operational plans.	Recording system implementation can create employee issues around compliance and system usage
Allow monitoring of day-to-day activities	Security issues with both electronic and physical records
They are essential for the effective control of finances and credit.	Physical records are prone to loss and damage
They are the basis for the monitoring and review of business activities that can lead to improvements in performance and profitability	Issues with accessing physical records
Have the capacity to fine tune and improve production performance	Limited collaboration of physical records

2. Complete the table to Identify and describe 5 non-financial records. (refer to Worksheet 4 for financial records)

	Record type	Description
Non-financial records	Production records	These records document everything produced on farm. Mostly prepared on a weekly basis which add up to monthly and annual records. Records monitor the value of the farm produce, measure progress in production and enable individual farmers to access farm credits.
	Record of agricultural inputs	Show type and amounts of farm inputs such as seeds, fertilizers replacement stock, hay etc. The farmer records amount purchased, amount used and amount left for each month.
	Records for farm use	Record dates for land preparation, planting of different paddocks, sale or utilisation of produce and rotation programs. Also include issues encountered such as disease and pest outbreaks.
	Records of livestock and livestock products	Each livestock enterprise needs different records. Milk records and egg records are good examples of livestock products records.
	Records of animal feeds	These records show the types and quantity of feeds used and the amount of feed available.

3. Select and research a current digital recording system available in Australia. For your chosen system identify what is recorded and evaluate its impact on production.

Answers will vary.