

This assessment is based on a now-expired version of the achievement standard and may not accurately reflect the content and practice of external assessments developed for 2024 onwards. No part of the candidate's evidence in this exemplar material may be presented in an external assessment for the purpose of gaining an NZQA qualification or award.



Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science RAS 2023

**91930 Demonstrate understanding of how soil
properties are managed in
a primary production system**

EXEMPLAR

Achievement

TOTAL 11

Page 1 – Pilot Assessment

NOTE

'Soil properties' refers to physical, chemical, and biological aspects of soil.

A soil management practice is carried out by the grower to improve or modify plant growing conditions.

Choose a primary production system to answer ALL THREE questions.

Primary production system:

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

QUESTION ONE: Soil pH

(a) What is soil pH, and what effect does it have on soil properties and plant growth in your primary production system?

B I U

Soil pH is the level of acidity of your soil and will determine the amount of nutrient availability in soil. pH has a level of 1 to 14 with 1 being very acidic, 7 being neutral and 14 being very basic. Soil pH affects the soil properties as it influences how well the soil chemical, physical and biological properties work. Depending on how well the soil properties work will determine plant growth as they need very specific results for maximum growth. A soil's nutrient status and retention is decided by the soil's pH level, for example a pH level of 6.5 will give the soil the best nutrient status and retention as it's a good balanced level being neutral but that slight acidity. To adjust soil pH you can apply lime or fertiliser, lime lowers acidity whereas fertiliser adds acidity. In Dairy farming we want maximum pasture, crop and plant growth as dairy cows need to produce a lot of milk and they make this from getting nutrients and energy from grass and crops, so therefore the farmers need to produce a lot of food for a cow to keep up with the high milk demand.

(b) Evaluate a management practice used to modify the pH of soil in your primary production system.

In your answer you should consider:

- the health of the soil
- how the management practice helps optimise plant production.

B I U





A management practice that can be carried out in dairy farming to modify soil pH can be applying lime. Applying lime is the process of limestone being crushed up into granular powder and being applied to soil via either truck, quad or aeroplane. In this case the soil may be too acidic and its production rate may be stunted, it's not as healthy as it can be and is dry and not producing enough succulent grass or crop this is when the farmer should apply lime to lower the acidity of soil to ideally 6.5, this will then give the soil maximum nutrient status and retention and the soil will be able to take in more nutrients and therefore give a high yield and production rate. Carrying through "Liming" will overall increase the health of the soil and create better and more consistent production also by doing this management practice will show Tiakitanga as the farmer is showing respect for the land and doing their best to ensure the land is healthy and looked after, this will benefit the farmer and/or future farmers and the land will be healthy and suitable to use in the future as it is well cared for. Showing respect to the land is very important as the land needs to be cared for to be able to give back to us and supply our needs, so for an understanding looking after our land will not impact and influence the land but also us ourselves.

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QUESTION TWO: Soil compaction or pugging

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.





- (a) Describe a management practice that can be carried out in your primary production system that helps **avoid** soil compaction or pugging.

B I U    
A management practice that can be used to avoid soil pugging and compaction is Cultivation. Cultivation is done by using heavy machinery to turn over top soil and make it into a crumb texture. Doing Cultivation in dairy farming will help avoid soil compaction or pugging as once the soil has been compacted it will turn over the soil and bring it back up to a healthy state where the soil structure can regenerate and pore spaces can be made for good aeration and drainage so the soil can respire. This will also make it harder for cows to pug the soil as the soil wont be as compacted and wet and will be able to be used for longer. Once again this is showing Tiakitanga as it is respecting the lands health and is maximising land production and duration.

- (b) (i) What soils are more susceptible to soil compaction or pugging?

B I U    
Clay soil is more susceptible to soil compaction and pugging as clay soil has the smallest pore spaces giving them more vulnerability, they don't have as much room between soil particles as sand and silt meaning clay gets squashed easier and oxygen and water don't have enough room to move through the soil profile making it hard for the soil to respire which therefore leads to a wet, cold soil which becomes pugged from stock.





- (ii) What are the effects of soil compaction or pugging on soil properties in your primary production system?

B I U    
In dairy farming pugging and compaction of soil are a huge risk as a lot of stock (cows) in one soil area that is poorly aerated and drained can lead to huge damage to the soil and it's health. Compaction and pugging occurring can completely disrupt the soil as it damages the soil structure and properties which furthermore leads to ruined yield and production. In dairy farming there is a high demand in food for the cows and with compaction and pugging occurring this restricts the demand and leads to farmers seeking other food sources to meet the desperate demand. The effects of this is much more than decreased production but also can cause a permanant damage to the soil.

- (c) Evaluate a management practice used to **restore** compacted or pugged soil properties in your primary production system.

In your answer consider how the management practice:

- optimises plant production
- ensures the long-term sustainability of the production system.





B I U    
An evaluation of Cultivating the soil is that turning over the soil can restore and restart the soil and it's health. It can save it from endangerment and help increase it's production. This can be caused as cultivating the soil will break up the structure and help the soil regain a healthy structure and let the pore spaces be able to allow oxygen and water to move through, allowing respiration and transpiration to occur giving the soil it's best chance at high nutrient intake and uptake from the roots and good production to produce food for the cows. This is the best example of Tiakitanga as the farmer is doing his best to let the soil do it's best, they are considering the soil's health and production rate and doing what they can to increase all aspects of this which will eventually pay him back for a longer and stronger time duration and high production rate.

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QUESTION THREE: Soil temperature

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

(a) (i) How does the composition and structure of soil affect soil temperature?

B I U    
Composition and structure affects soil temperature as it determines how much space is available for oxygen and water to move through the soil's profile. The temperature is based on how much oxygen and water is in the soil profile and too much of it can cause the soil to be too hot or cold. Ideally we want the soil's temperature to be around 18 degrees Celsius but anyway from 18 to 30 is good, below 6 degrees Celsius is too cold and above 30 degrees Celsius is too hot. The soil needs to be the right temperature to be eligible for respiration, transpiration and photosynthesis. These are very important for a soil's health and production and needs to be just right for the best result. Soils with bigger pore spaces often have better temperature as there is more space for water and oxygen to move through, whereas smaller pore spaces in soils can risk it being too hot or cold. Soil still needs to have a pretty warm temperature for rate of reactions to occur as warmer temperature leads to faster rates of reaction which impacts germination and photosynthesis.





(ii) What are the impacts of temperature on the biological properties of soil?

B I U    
Biological properties in soil are Organic matter and Living organisms these depend on the soil's temperature. Living organisms like earthworms tunnel through the soil but like bigger pore space soils better as it is easier. They tunnel through and it creates aeration and drainage for the soil.

(b) Evaluate how a specific management practice is used to modify soil temperature.

In your answer you should consider how this management practice:

- optimises plant growth
- demonstrates care for the environment.

B I U    
A management practice that would best modify soil temperature would be drainage. Drainage is done by artificially removing excess water and creating space for drainage to occur in soil. Drainage would be ideal to modify temperature as it ensures the soil isn't accessing too much water which can lead to temperature being too hot or cold. This will keep the soil at an ideal temperature of 18 degrees Celsius and this will maximise plant growth as there will be faster and more consistent rates of reactions, respiration, transpiration and photosynthesis. This will increase plant growth as the soil and plant has their best opportunity at nutrient availability and can take in for nutrients to be able to grow. Overall carrying through drainage to the soil is greatly representing Tiakitanga and everything the farmer does and considers is for the land and it's well being, they are showing how important the land means to them and giving the land it's best chance of health and future service to them and/or future farmers. In the end all the farmers hard work and dedication to the land will give back to him as the land will serve them good time and result. Showing Tiakitanga is also a bonus financially as it won't be as expensive to upkeep the land as it won't have as much problems as it is well looked after so therefore it is a bonus to the farmer just as much as the land, soil and plants.

Achievement

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 11

Q	Grade score	Marker commentary
One	A4	Candidate shows an understanding that soil pH is the level of acidity in the soil, and this can be managed by using lime. The response shows the candidate understands that adding lime will decrease the acidity of the soil. For a Merit, the candidate needed to explain why changing pH optimises plant growth.
Two	A4	Candidate understands that pugging and compaction can lead to poor pasture yield and that cultivation is a practice that farmers use to restore the soil. For a Merit, the candidate needed to link soil physical properties that are modified by cultivation to optimise plant growth.
Three	A3	Candidate shows some understands that drainage affects the soil temperature by removing excess water but has not stated whether removing water will make the soil warmer or colder. For a more solid achieved, the response needed to show how removing water will increase the air in the soil and therefore warm the soil.

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science RAS 2023

**91930 Demonstrate understanding of how soil
properties are managed in
a primary production system**

EXEMPLAR

Merit

TOTAL 15

Page 1 – Pilot Assessment

NOTE

'Soil properties' refers to physical, chemical, and biological aspects of soil.

A soil management practice is carried out by the grower to improve or modify plant growing conditions.

Choose a primary production system to answer ALL THREE questions.

Primary production system:

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

QUESTION ONE: Soil pH

(a) What is soil pH, and what effect does it have on soil properties and plant growth in your primary production system?

B I U

soil pH is the acidity of soil and has a range between 4 and 10. 4 being very acidic and 10 being very basic. the ph of the soil matters for plant growth for a number of different reasons. if the soil is too acidic, micro organisms like worms and other bacteria are killed or move out of the soil. worms affect the plant growth by digging tunnels that allow roots to penetrate deeper into the soil therefore allowing them to reach more nutrients to help speed up the process of photosynthesis. if a soil is too acidic or too basic most of the micronutrients and macronutrients needed for plant processes like photosynthesis, respiration and transpiration are not available to the plant meaning the plant cannot survive. the ph of soil is found out by taking soil tests.

(b) Evaluate a management practice used to modify the pH of soil in your primary production system.

In your answer you should consider:

- the health of the soil
- how the management practice helps optimise plant production.

B I U

liming is a management practice used to modify the pH of the soil. lime (calcium carbonate) is basic. lime can be applied by either cultivating it into the soil to speed up the reaction rate or by spreading it on top of the soil. liming also unlocks the necessary nutrients in the soil to optimise plant growth. this is relevant to the maori value Kaitiakitanga which is to show care and respect for the land, by liming we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.

Page 2

QUESTION TWO: Soil compaction or pugging

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

- (a) Describe a management practice that can be carried out in your primary production system that helps **avoid** soil compaction or pugging.

B I U

a management practice that can be carried out to avoid soil compaction or pugging is spreading organic matter in the soils. spreading organic matter in market gardens can be carried out by either digging it in to the soils which is more effective or by spreading it on top of the soils as a mulch. spreading organic matter is especially effective on clay and sandy soils because the clay soils have very small particles that are compacted very close together so spreading mulch through the soil spreads apart the soil particles allowing for water to pass through and allowing air to flow in. spreading organic matter does the opposite for sandy soils, it clumps together the sand particles helping it hold on to more water and not allowing leaching which is when water carries away the nutrients. it also adds nutrients in the soil that the plants need to speed up the process of plant processes like photosynthesis and respiration. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.

- (b) (i) What soils are more susceptible to soil compaction or pugging?

B I U

clay soils are more susceptible to soil compaction or pugging because they have very small particles that are compacted tightly together. this means that the soil cannot drain very well and holds on to water because of the small particles. this means that the air flow is very little in the soil because they are often waterlogged. the smaller particles means that they can compact closer together.

- (ii) What are the effects of soil compaction or pugging on soil properties in your primary production system?





B I U

the effects of soil compaction or pugging on soils in market gardens is that compacted soils hold on to water and do not drain so they are often water logged meaning there is no air flow within the soil. the optimal plant growing soil should consist of 50% organic material 25% water and 25% air so if there is more water therefore there is less air so plant processes like photosynthesis happen slower. an effect that soil compaction has on chemical properties is the nutrients of the soil are not able to be reached because the roots cannot push into the compacted soil so the soil retention is low. an effect soil compaction has on the biological properties of soil is microorganisms like worms and bacteria are unable to help with the nutrient status of the soil because they cannot dig through the soil as easily

(c) Evaluate a management practice used to **restore** compacted or pugged soil properties in your primary production system.

In your answer consider how the management practice:

- optimises plant production
- ensures the long-term sustainability of the production system.





<p>B I U    </p> <p>a management practice that can be carried out to restore compacted or pugged soils is cultivation. cultivation in market gardens is done usually by hand or using tools like rakes and shovels. it is carried out by ripping up the soil. cultivation is especially effective on clay soils because the clay soils have very small particles that are compacted very close together. this means there is little air flow in the soil and too much water. cultivation is carried out to restore compacted soils and maximise air flow in the soil for the ideal plant growing conditions. it also unlocks nutrients in the soil that the roots could not reach speeding up the process of photosynthesis. cultivation makes the soil temperature rise because it allows more air into the soil and air heats up faster than water so the soil is warmer which speeds up the process of photosynthesis. however overcultivation reduces nutrients in the soil so growers need to be careful not to overcultivate the soils. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.</p>
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Page 3

QUESTION THREE: Soil temperature





Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

(a) (i) How does the composition and structure of soil affect soil temperature?

B I U    

the composition and structure of the soil affect soil temperature because a clay soil which has very small particle sizes does not allow drainage and water to flow through which means that they are often water logged and have not much air in them. air heats up faster than water so a soil with more air and less water will heat up faster therefore clay soils are cooler. sandy soils have a very big particle size so the micropores and macropores are larger allowing drainage to happen very quickly therefore there is more air in the soil so the soil will heat up faster. therefore sandy soils are generally warmer

(ii) What are the impacts of temperature on the biological properties of soil?





B I U    

the impacts of temperature on the biological properties of soil is that microorganisms within the soil like the warmer soil so there will be more worms and other organisms in warmer soil. therefore the nutrient status in the soil is higher. the higher nutrient status within the soil means that the plant processes e.g. photosynthesis respiration and transpiration are sped up

(b) Evaluate how a specific management practice is used to modify soil temperature.

In your answer you should consider how this management practice:

- optimises plant growth
- demonstrates care for the environment.

B I U    

a management practice used to modify soil temperature is drainage. drainage can be carried out in many different ways either by above ground or below ground drainage systems. above ground drainage systems are things like open ditches and creeks, below ground drainage systems are done by mole ploughs etc and are sloped downwards to allow the flow of water and lead to open ditches and creeks. this management practice modifies the soil temperature because it carries away excess water allowing for a higher air flow in the soil. air heats up faster than water so air flow in soil is important to maximise the temperature in the soil which therefore speeds up the plant processes like photosynthesis. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.

Merit

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 15

Q	Grade score	Marker commentary
One	A4	The candidate has understood soil pH and how lime modifies the acidity of the soil, but they have not understood why having an ideal soil pH will improve plant growth.
Two	M5	The candidate has explained that by cultivating the soil it will break apart the soil, improving air flow, allowing roots to reach nutrients and warm the soil. For a more solid Merit, the candidate would have linked improved air flow to respiration and plant growth.
Three	M6	The candidate has explained that drainage will remove excess water, allowing more air flow into the soil, and therefore increasing the temperature, and speeding up plant processes. This is not an Excellence as the candidate has not evaluated the use of drainage by discussing the cons or any additional benefits apart from removing water.

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science RAS 2023

**91930 Demonstrate understanding of how soil
properties are managed in
a primary production system**

EXEMPLAR

Excellence

TOTAL 21

Page 1 – Pilot Assessment

NOTE

'Soil properties' refers to physical, chemical, and biological aspects of soil.

A soil management practice is carried out by the grower to improve or modify plant growing conditions.

Choose a primary production system to answer ALL THREE questions.

Primary production system:

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

QUESTION ONE: Soil pH

(a) What is soil pH, and what effect does it have on soil properties and plant growth in your primary production system?

B I U    

Soil pH is how acidic or basic a soil is. Ideal soil pH is 6.5. It's important for the soil pH to be at the correct level because if soil is too acidic or basic nutrients can become locked up and insoluble meaning cant be used for nutrient uptake which increases the growth of the plant.

(b) Evaluate a management practice used to modify the pH of soil in your primary production system.

In your answer you should consider:

- the health of the soil
- how the management practice helps optimise plant production.

B I U    

A management practice to help the soil pH is liming. Liming is the processes of adding calcium carbonate to a soil to decrease it's acidity and bring it back to the correct pH level of around 6.5. Adding lime to a soil encourages living organisms to break down organic matter into humus which will release nutrients for the plants to take up as a part of nutrient uptake (The process of nutrients being souble and dissolved in water so plants can then take it up and use for growth) which will increase the growth of the plants. It encourages them because they can only work and break down orgainc matter if the soil is at a good pH. Lime also prevents nutrients from being locked up and insoluble. If the nutrients are locked up and insoluble they cant be used as a part of nutrient uptake and therefore plants will be lacking in nutrients which will decrease growth rates. However adding lime is an expense to the farm as they will have to buy the lime and pay for it's application if they haven't got the right tools to apply it themselves. In comparison to not adding lime the soil will lack nutrients as the micro organisms that are breaking down the organic matter into humus to release nutrients will be slowed because they cant work well under acidic conditions. It will also lack nutrients because some of the nutrients will be insoluble due to the soil being too acidic. These are two ways the soil will now lack nutrients due to no lime being added to the soil. The farmer however wont have to pay for the lime or it's application, this money could be spent on other things around the dairy farm. Adding lime to the soil is showing manakitanga to the soil because the farmer is caring for the soils needs and respecting that if they want production off the soil they need to respect and help it as well. It's very important to add lime to your soils if it is needed because it is a small price to pay for healthy soils that will be nutrient rich and not have insoluble nutrients within them. Having healthy soils full of nutrients will increase nutrient uptake which will increase plant growth and yield meaning the cows on the dairv farms production will be increased.

Page 2

QUESTION TWO: Soil compaction or pugging

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

- (a) Describe a management practice that can be carried out in your primary production system that helps **avoid** soil compaction or pugging.

B I U	☰ ☷	↶ ↷
Cultivation is a management practice that prevents soil from being compacted. Cultivating is usually done by an implement called a cultivator being towed behind a tractor. The process of cultivation breaks up top soil and turns it over therefore will be breaking up and compacted soil particles.		

- (b) (i) What soils are more susceptible to soil compaction or pugging?

B I U	☰ ☷	↶ ↷
Soils with poor drainage such as clay soils are the most affected by compaction. This is because the soils usually have too much water and not enough air in their pore spaces which means they can be easily compacted.		

- (ii) What are the effects of soil compaction or pugging on soil properties in your primary production system?

B I U	☰ ☷	↶ ↷
Having compacted soils will mean very small pore spaces this means there won't be much air or water within them for plant growing processes. Compacted soils tend to have very poor structure, drainage, aeration and temperature due to the small compacted pore spaces. This is because there is only room for a little bit of water in the pore space and the rest will have to drain away and because the soils that often get compacted aren't usually good at draining this may take a long time. There will also only be a small amount of air in the particles meaning the soil won't be well aerated which will mean it's cold and rates of reaction will be slowed. Having compacted pore spaces and soil particles will also mean soil structure is bad.		

(c) Evaluate a management practice used to **restore** compacted or pugged soil properties in your primary production system.

In your answer consider how the management practice:

- optimises plant production
- ensures the long-term sustainability of the production system.

B	I	U	☰	☰	↶	↷
<p>The management practice cultivating is done by turning over over the top soil of a paddock to take away the compacted soil so that it can be restored back into healthy soil. When cultivating it breaks up the compacted soil particles and allows good levels of air back into the soil's pore spaces. If a soil is well aerated it will mean there is plenty of oxygen for the plants roots to use for respiration. Respiration creates a chemical energy (ATP) that plants use to grow. Having a well aerated soil also means that the soil will be a warmer temperature then if the soil was poorly aerated. Having a good temperature will mean that rates of reaction are speed up and the plant growing processes will be able to happen faster which will increase the production of the plants. Cultivating also helps to put the organic matter that was spread through the top soil deeper into the soil. This is important because the organic matter will help improve the structure further down in the soil which will increase pore spaces and improve the aeration and drainage deeper in the soil which is especially important for deeper rooted plants. It will also increase the nutrients being released deeper down and will help increase nutrient uptake to plants. However when cultivating there is a risk of over cultivating. This means it's been done too much and has ruined the structure of soil. It's important not to cultivate your soil too often and only when needed to ensure sustainability of your soil. Compared to not cultivating where there is no risk of over cultivating and ruining the structure of the soil for a long time but it will mean there will be a lack of organic matter spread through deeper soils which will mean poor structure and not enough water in the pore spaces for the plants to use for photosynthesis (The process of plants making glucose for themselves to use as food for growth). Also not enough air in the pore spaces for plants to use for respiration which also translates to growth. There will also be a lack of nutrients for the plants to use for nutrient uptake (transpiration). The top soil will also stay compacted with little air in pore spaces for respiration. Cultivating the soil when needed shows manakitanga because the farmer is caring for his soil and wanting it as healthy as it can be. Its very important to cultivate soil as it helps with increasing air and water in pore spaces due to it improving structure. This means it helps with all three plant growing processes which will increase the plant growth and ensure a sustainable farm.</p>						

Page 3

QUESTION THREE: Soil temperature

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

(a) (i) How does the composition and structure of soil affect soil temperature?

B I U

The composition and structure of a soil affects the temperature of a soil because if the soil is well aerated it will have a warmer temperature because air is easy to heat up. If a soil has bad aeration and bad drainage it will be a cool temperature because it will be hard to heat up as there is little air and more water which is difficult to heat up.

(ii) What are the impacts of temperature on the biological properties of soil?

B I U

Temperature impacts plant growth which will impact living organisms because if a soil is healthy and has good plant growth due to a good temperature the living organisms will also be healthy. If the soil is healthy and warm the living organisms will break down organic matter at a faster rate meaning it can be used faster. A good temperature also rates of reaction for plant growing process (photosynthesis, transpiration, respiration) which both living organisms and organic matter take part in.

(b) Evaluate how a specific management practice is used to modify soil temperature.

In your answer you should consider how this management practice:

- optimises plant growth
- demonstrates care for the environment.

B I U

The management practice adding compost is the process of adding breakdown down plant and animal waste to a paddock. This is done to increase the organic matter through a soil. When adding the compost it is adding organic matter to the soil as well. The living organisms within the soil then break this organic matter down into humus which will act like a glue to soil particles and help them hold together this will increase the pore spaces and mean they will be well aerated and have improved drainage. Soils with good aeration are warmer as they are easier to heat up than soils with minimum air. When a soil is warmer it will increase rates of reaction meaning the three plant growing processes photosynthesis (creating glucose for their own energy and growth), respiration (creating a chemical energy called ATP for growth) and transpiration (nutrients being dissolved and taken up for growth) will be speed up and therefore plant growth will be speed up which will increase the production of the farm. Compost is also dark and so is the organic matter within it this means that the sun will be attracted to it in and outside of the soil. This will heat up the soil and again increase rates of reaction however compost is very expensive to buy and time consuming for the farm to make themselves. This is a cost to the farm that could be used on other things if needed. In comparison if the farm didn't put compost through their soil it would mean one less expense but there also wouldn't be the organic matter being added to the soil to increase the pore spaces which will increase the air in soil for respiration and water in soil for transpiration and photosynthesis. All three of these things improve plant growth and production by creating an energy for growth. With the lack of organic matter the soil also won't be attracting so much sun therefore won't reach such high temperatures. Adding compost shows that the farmer is caring for their soil because they want it to be healthy with good properties. It is also showing care to the environment by using recycled materials to improve soils and the land and animals in the environment. It is important for the farmer to add compost even though it is a cost because it will majorly improve plant growth by improving the three plant growing processes which will improve production of the whole farm.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 21

Q	Grade score	Marker commentary
One	E8	Candidate has evaluated the use of liming to increase the soil pH to achieve ideal soil pH. The use of lime is linked to soil properties, and the cost of lime is discussed. The consequence of not using lime has been included in the response. The response shows logical links between the management practices and soil properties that improve the health of soil.
Two	E7	Candidate has evaluated the use of cultivation to restore pugged or compacted soil. Cultivation is linked to soil properties and plant processes that will benefit from a more aerated soil. For a more solid Excellence, the candidate should have linked cultivation to long-term sustainability.
Three	M6	Candidate shows a good understanding of soil temperature, and the effects temperature has on the biological properties of the soil. For an Excellence, the candidate should have chosen a more realistic management practice for a dairy farming context that they could then evaluate fully.

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Level 1 Agricultural and Horticultural Science RAS 2023

91931 Demonstrate understanding of sustainability considerations that influence primary production management practices

EXEMPLAR

Achievement

TOTAL 04

Write your report below:

Water could be considered the lifeblood for all primary industry producers and overall plays an essential role in our environment. So it is important that all farmers are carefully managing the water/rivers in a sustainable way to ensure the waterways are healthy and protected not only for the present but for the future as well. The type of farming I'm going to be referring to in this report is Dairy farming and the management practices I'll be suggesting/including are riparian planting and riparian fencing, and discussing how it is sustainable for the water by referring to nearby rivers.

Riparian planting is the process of planting native plants such as flax, along the river banks usually right next to the paddocks where the livestock graze. It is done by planting a whole bunch of native plants like flax along the river bank usually situated right next to or below the area the cattle is being farmed. Riparian planting is an excellent management practice farmers are able to do because it is efficient(easy to do and manage), has no negative effects, and provides many benefits. First of all it keeps the water quality and appearance clean by stopping all the waste(fertilizer and feces) from washing down into the river, which is called leaching. This is because the nutrients that are in the waste, the plants like and absorb them to enhance their own growth. Also the native plants provide a natural ecosystem for many different species to live and thrive. From doing this it shows kaitiakitanga and manaakitanga for not only the waterways and the native plants/species but also preserving the water for future generations to swim and use. To extend on that the farmer is doing good for themselves if they use the water for the cattle to drink.

Another management practice the farmer is able to do is riparian fencing. Riparian fencing is extra kaitiakitanga to riparian planting in terms of sustaining the water . It is when the farmer also lays a fence around the riparian plants. It comes with all the positive and benefits of riparian planting, but the extra protection that it adds is keeping the cows completely out of the river. Because if it wasn't there the cows would still be able to get into the river and possibly drop its feces in the river, which defeats the whole point of the riparian planting.

Out of both management practices I've discussed, I personally think that riparian planting has the greatest impact in sustainability for the water. I think this because it comes with many more benefits compared to riparian fencing alone. The only effect riparian fencing has is 100% keeping the cattle out from the river, but riparian planting includes more benefits such as the native plants creating habitats for many species, natural leaching sponges, and it still also could somewhat keep the cattle out of the river. To all dairy farmers that own land surrounding rivers, I highly recommend investing in riparian planting because it comes with so many benefits that could impact yourself, others, and the environment.

Achievement

Subject: Agricultural and Horticultural Science

Standard: 91931

Total score: 04

Q	Grade score	Marker commentary
One	A4	The candidate shows understanding of why a dairy farmer would fence and riparian plant the waterways around their farm. The response shows a good understanding and connection of kaitiakitanga and themes of tūhononga. The candidate has not explained in detail how the management practices would improve water sustainability. For a Merit, detailed links needed to be made between the management practices and how they prevent the negative impacts on the water of dairy farming.

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science RAS 2023

91931 Demonstrate understanding of sustainability considerations that influence primary production management practices

EXEMPLAR

Merit

TOTAL 06

Water sustainability:

Sustainability in agriculture means the production of food, animals and plants using farming techniques that prove to be beneficial for public health and promote economic profitability. Dairy farming impacts the environment, by the cow's urine producing a surprising amount of methane, notorious oxide which comes from the stock's urine, CO₂, and many other greenhouse gases that are released into the air. My two management practices that tie in with dairy farming are riparian margins and effluent management. Riparian margins are the planting of native bush/plants around native waterways to protect the water, stabilize soil and prevent erosion. Riparian margins decrease the number of faecal pathogens, sediment, and nutrients from leaching/running off into the waterways. With all these sediment/nutrients/pathogens leaching into the water it causes algae growth, and sickness of people/animals. When algae grow, it then turns to a biomass of algae bloom which can lead to eutrophication, this is when there is not enough dissolved oxygen in the water for the living organisms/water to stay fresh because it will become toxic. Waterways need 50-80% of dissolved oxygen because algae uses oxygen to respire, and the water will become toxic. As the planting helps with nutrient uptake, if there is too much from stock or fertiliser it is still able to get into the water. The margins also help with shading of the water, which need to be 70% shaded for the sustainability otherwise the algae can photosynthesize. The water also needs to be 10 degrees, or this process will carry out. The environmental considerations of riparian planting are prevention of erosion, livestock injuring themselves and keeping the waterways fresh for the environment to look clean and healthy for future generations. The economic consideration of this is the prevention of livestock not being able to injure themselves, by falling into the water or hurting themselves and prevention of erosion is cared for, so the financial problems are decreased. The social impacts are as the water is kept clean and fresh it looks nice, can be swam in by people and the planting can also help with jobs for people in need.

My other management practice is effluent management. Effluent is the waste of cows (poo and wee), that can be stored in effluent ponds until it is ready to be spread onto the paddocks. Effluent comes from milking sheds, animal shelters, holding stands and runoff pads. Effluent is a natural, dilute fertiliser that contains phosphorus, nitrogen, potassium, sulphur, magnesium, and any natural resources that is found in fertiliser that is brought in a shop. It is stored until ready to be spread, but there can be some risks involved including, when it is too wet it can cause runoff into the waterways/leaching and ponding polluting the waterways, spreading too much and the spray mist spreading into the water. This can provide for the algae to grow. When effluent is spread it allows for maximum nutrient uptake and maximum grass growth. As the grass becomes healthier this allows for the cows to become more healthy, bulky and the milk quality will increase. To improve the water sustainability, it is important to follow the rules of spreading effluent from irrigators in paddocks near waterways. These rules include leaving a wide 20-meter strip from the waterways, so if the nutrients are to leach/runoff they are not able to leach that far to the waterways, make sure fertiliser mist does not drift off into the waterways, and do not spray within 50 meters of a water supply. The maximum amount of fertiliser applied per person is 150kg per hectare of grazed grass annually. The environmental considerations of effluent are with it being a natural fertiliser are that the resources are natural meaning the cows/grass/soil will not get exposed to anything toxic, and the effluent being stored in ponds means it can sit till it is ready to be used. As economic considerations, the fact that the effluent is spread as natural resources from the dairy farm means the financial costs are decreased as you do not buy many things other than to irrigate it. The grass will become healthy, and the waterways will already be sustainable if spreaded correctly. Social considerations are the grass looking healthy for people, and the process can help with people in need of jobs.

A Māori value that is relevant to sustainability in dairy farming and the two management practices is tiakitanga. Tiakitanga means guardianship and protection of the land, and the responsibility to care for and protect the land, food, animals for future generations. Tiakitanga is shown with the riparian margins and effluent management improving the water sustainability. By protecting the land and ensuring it is cared for, e.g., planting plants and spreading effluent the future generations can sustain that and will be proud as you protect your land for the future generations.

I believe that out of these two management practices riparian margins will have the greatest impact upon the sustainability of water, because of all the benefits it produces. The prevention of stock injuries, nutrient runoff and leaching is a massive benefit as few other management practices will prevent most of these. With riparian margins being better than effluent, this is because of the shading the plants produce for the water to stay healthy and reduce the algae rate of photosynthesizing. Effluent does not do this, but it still has some impacts on the water sustainability, including spreading it right by following the rules can not harm the water. Overall riparian has a more beneficial effect on the water quality, with many considerations being positive and tiakitanga being showed throughout the process.

Merit

Subject: Agricultural and Horticultural Science

Standard: 91931

Total score: 06

Q	Grade score	Marker commentary
One	M6	The candidate has explained in detail the impacts that dairy farming can have on water sustainability. They have linked the use of riparian planting and correct effluent application to reducing the negative impacts that dairy farming can have on water. The candidate has shown a good understanding of kaitiakitanga. For a higher grade the candidate needed to justify the use of riparian planting by saying how it will improve the sustainability to a greater extent than effluent application. The candidate needed to cover social or economic sustainability for Excellence.

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science RAS 2023

91931 Demonstrate understanding of sustainability considerations that influence primary production management practices

EXEMPLAR

Excellence

TOTAL 08

The dairy farming production system encompasses the breeding, raising and milking of dairy livestock (particularly cows). Unfortunately, when water management practices are not performed, dairy farming pollutes nearby waterways with excessive nutrients from livestock's effluent deposition and overapplication of fertilizers.

Riparian planting is a water management practice performed in dairy farm systems to protect the nearby waterways. When carrying out the management practice farmers should plant water tolerant scrubs on lower banks near waterways, small trees and flaxes on the upper banks and leave grass strips between vegetation and fences. The riparian margins stabilise the banks with their tightly held root systems, preventing erosion and loss of sediment into the water. Sediment from dairy farms typically contains nutrients that are considered as water contaminants, contributing to Eutrophication. As nutrients, especially Phosphorus and Nitrogen, enter the water through run-off, leaching or direct deposition, they promote the excessive growth of algal blooms. Algal blooms consume the water's dissolved oxygen at considerably fast rates on cloudy days and at night. Without this oxygen the water is deoxygenated and becomes anoxic. Anoxic water is toxic for all aquatic organisms and life that are found in that water source. Riparian vegetation also filters and utilizes high amounts of nutrients from dairy farm run-off and leaching before they can pollute and eventually deoxygenate the water. Additionally, riparian margins provide shade, cooling the water temperatures. Rivers require 70% shade and a temperature of 10 degrees Celsius for optimal conditions to be achieved. Riparian margins present the Māori value of Tiakitanga, referring to the guardianship and protection of our land and natural resources for future generations. Although riparian planting has no immediate economic gain, as farmers prevent the contamination of water sources, they are being socially sustainable, maintaining the condition of our waterways for future generations of rural communities to use and successfully sustain economic benefit from.

Effluent is a nutrient-rich natural resource that is produced by livestock and released as urine and poo. Effluent, collected from milking sheds, holding yards and stand-off pads, is diluted with water to become a supplementary liquid irrigation system on dairy farms. Effluent contains Nitrogen, Phosphorus, Potassium, Magnesium, Sulphur, and other trace elements dairy farmers usually purchase to fertilise their pastures with. When performed and controlled well this management practice is socially, environmentally, and economically sustainable. Each dairy cow typically produces \$25 worth of nutrients annually as Farm Dairy Effluent (FDE). Therefore, a 400-cow herd produces approximately \$10,000 worth of nutrients annually as FDE. This offers an opportunity to capitalise on a cost-effective natural resource. When applied to paddocks effluent promotes pasture and crop productivity which in turn provides dairy livestock with a sufficient food source. To control this practice, farmers must ensure the effluent drift will not reach the water, consider their soil deficit, leave a 20-meter strip of unirrigated land, and not irrigate within 50 metres of a water source. Soil deficit refers to the volume of water that the soil can hold before it reaches 'field capacity.' If farmers where to irrigate with effluent after it reaches capacity, it is likely that ponding, run-off, or leaching will occur, potentially severely damaging the waterways. Effluent, like commercial fertilisers, contains nutrients that can cause water contamination at high concentrations. Making sure that their effluent irrigation is performed both effectively and responsibly prevents the risk of Eutrophication, a harmful cycle of water deoxygenation and degradation that I have explained in my previous paragraph. By managing effluent effectively, farmers can recycle and capitalise on a natural resource while preventing the contamination of waterways. If dairy farmers did not control effluent, it would pollute and degrade the nearby water sources severely. When performed well, effluent management shows Manaakitanga, respect and consideration of the land and waterways on the farm and around it. This consideration of environmental and social sustainability prevents any harm that can be associated

with irresponsible effluent management. When members of society drink from or swim in water downstream, their health and wellbeing has been considered and the risk of illness reduced.

Overall, planting riparian margins will have the greatest impact upon water and environmental sustainability as it actively reduces the contamination of water ways and although it has no large immediate economic benefit, it sustains the health of our land's natural resource for use by future generations of New Zealand rural communities and animals. Effluent management is environmentally and socially sustainable, preventing water contamination and maintaining safe waters, but it is often instead performed by dairy farmers due to the economic sustainability consideration of pasture productivity and overall milk production for sale. If accidents happen while effluent irrigating, riparian vegetation stops the associated nutrients entering and degrading the water. Therefore, when planned and planted correctly, riparian vegetation reduces the nutrient contamination and eutrophication of waterways significantly, successfully improving water sustainability.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91931

Total score: 08

Q	Grade score	Marker commentary
One	E8	<p>The candidate has evaluated riparian planting by explaining how it can improve water sustainability. The candidate has discussed both environmental and social sustainability considerations of riparian planting. The candidate has evaluated effluent by explaining the negative effects effluent can have on the water if applied incorrectly. They have discussed how to apply effluent to reduce the chance of water pollution and have discussed both economic and environmental sustainability considerations when applying effluent. The candidate has demonstrated a good understanding of tiakitanga in their response.</p>