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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Agricultural and Horticultural Science 2023

91532 Analyse a New Zealand primary production environmental issue

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Analyse a New Zealand primary production environmental issue.	Critically analyse a New Zealand primary production environmental issue.	Comprehensively analyse a New Zealand primary production environmental issue.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL parts of the task in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL 08

Primary product: Dairy

STIMULUS MATERIAL

New Zealand's greenhouse gas emissions.

Source: (adapted) https://www.sciencemediacentre.co.nz/2010/07/01/emissions-trading-scheme-launched/

PLANNING

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TASK: How the agricultural and horticultural sector is responding to New Zealand's greenhouse gas emissions

(a) How are greenhouse gases emitted in the production of your chosen primary product?

Use recent data (preferably from within the last five years) and other evidence to support your answer.

Agriculture in New Zealand has large impact on greenhouse gases with a MFE snapshot from Massey University in April 2022 revealing that Agriculture contributes 50% to Greenhouse gas emissions in New Zealand. With the Dairy industry contributing 23.5% making it the highest agricultural greenhouse gas producer. Greenhouse gases being contributed by the Dairy industry is majority Methane and nitrous oxide with carbon dioxide being emitted indirectly from dairy production.

Cows have four stomachs in order to breakdown and process grass. In the process of digesting this grass, enteric fermentation occurs which results in methane being produced inside the cow. This is then released mainly through burps. The average dairy cow produces 98kgs of methane per year. With 4.9 Million Dairy cows in New Zealand this results in large amounts of methane being emitted into the atmosphere. As well as enteric fermentation causing methane, methane can also be released from effluent ponds and waste management. As faeces are collected and stored gases are released from these systems into the atmosphere. Methane is 25-28 times better than trapping heat in the atmosphere than carbon dioxide and has a lifespan of 12 years. This causes it to have large effect on the environment as more and more methane is being released.

As well as methane, nitrous oxide is also produced due to the dairy industry. Nitrous oxide is created as cows each nitrogen rich feed. Only a small amount of nitrogen which they eat is then used in order for milk production which means the rest is then excreted into high intensity patches through urine and fesces. This is then acted upon by denitrifiers and denitrifucation occurs which causes nitrogen to turn into nitrous oxide and emitted into the atmosphere. Nitrous oxide can also be emitted when nitrogen fertiliser is used in order to improve grass growth. The process of spreadinfertiliserer releases nitrous oxide as well as it increasing the nitrogen levels in the grass which will increase the amount of nitrgoen released from cows in urine. Nitrogen is 250-300 times better at trapping heat in the atmosphere and has a lifespan of 120 years. Nitrous Oxide emisions have increased by 50% since 1990 which is mostly due to the expansion of the dairy herd in New Zealand.

Although not directly affected by dairy production carbon dioxide is released indirectly through farm machinery such as tractors and quad bikes. It is also released in the transportation of primary goods such as milk trucks and then also released in processing plants and milk factories when the milk is processed. So although dairy cows are neither adding or subtracting to the carbon dioxide levels, distribution and processing of their milk releases carbon dioxide.

(b) What steps are the New Zealand Government and industry taking to reduce the greenhouse gases emitted from the production of your primary product?

Use recent data (preferably from within the last five years) and other evidence to support your answer.

Both New Zealand Government and Dairy industry have made steps and commitments in order to Reduce greenhouse gas emissions. The New Zealand government has committed to the Paris Accord which states that our greenhouse gas emissions will drop 30% low our 2005 greenhouse gas levels by 2030. As well as this they committed to dropping our agricultural methane levels 25% low our 2017 levels by 2050. These are two commitments that the New Zealand Government has made to reduce our greenhouse gas emission with some specifically relating to the dairy industry. Furthermore propositions from the New Zealand Government have been made to tax farmers for their greenhouse gas emissions from 2025. This would directly impact farmers as they would be taxed depending on each individual farms emissions. This would significantly incentivise Dairy farmers to reduce their emissions in order to be taxed less.

As well as government commitments, large steps are being taken directly by the industry in order to reduce dairy greenhouse gas emissions. Industry leaders such as Fonterra the largest Dairy Company in New Zealand have invested large resources into finding solutions to decrease emissions whilst still ensuring viability of dairy production. Similarly companies such as LIC and Dairy NZ have also invested time, money and resources into researching and developing farm systems that lower greenhouse gas emissions. Solutions such as supplementary feeding, genetic development, tracking stock performance are all solutions which have been trialled and will continue to be trialled in order to test their effectiveness is constantly ongoing by leaders of the industry. Extensive and continuous research is being completed all with the goal of reducing greenhouse gas emissions. Although New Zealand is of the most efficient farmers in the world our systems can always be improved and also shared worldwide in order to reduce green house gas emmisions worldwide across the dairy industry.

(c) (i) What specific courses of action can be taken **by the producer** to reduce the greenhouse gases emitted in the production of the primary product?

Course of action (1): Supplementary Feeding

Supplementary Feeding is one action that can be taken in order to reduce methane and nitrous oxide outputs. Research has been carried out on the benefits of supplementary feeding cows which feed that can reduce methane and nitrous oxide outputs. Examples of this is Forage Rape, Fodder Beet and Asparagopsis. Forage rape has been researched that when fed as supplementary feed can reduce methane emissions by up to 30%. This is due to the fact that it is digested differently in the cows stomach and does not produce as much methane. As well as forage rape fodder beet can be fed out and has shown to decrease nitrous oxide emissions. Fodder beet does not hold as much nitrogen in comparison to grass and therefore does not cause nitrogen to be emitted through excretion and cause nitrous oxide to be emitted into the atmosphere. Lastly is Asparagopsis which is not currently used and still undergoing research into the commercial growth of it. Asparagopsis is a Seaweed that when fed to livestock has shown the ability to cut methane emissions by 50%. The research has proved its effectiveness however whether it is able to be grown commercially is still not proven to be viable and therefore it is not widely used by farmers yet.

All three of these examples, Forage Rape, Fodder Beet and Asparagopsis show how by feeding cows things other than grass it has the ability to reduce both methane and nitrous oxide emissions.

Course of action (2): Reduce Stocking Rate

One practice farmers are able to use is consistently analysing their stocking rate and stock performance. Stocking rate is one solution that can reduce emissions by up to 10% whilst still ensuring profitability. Stocking rate works on the principal that less cows means less greenhouse gases to be emitted. There is the ability for farmers to analyse cows performance and cull those that are not performing to a high level. A cow with low efficiency will eat the same amount of grass as a cow with high efficiency but not produce as much milk. Therefore the same amount of greenhouse gases are being emitted with not the same milk production. Therefore to reduce greenhouse gas emissions cows with low efficiency could be removed from the herd. This ties in with genetics as if we are able to breed efficient cows then less grass needs to be eaten but the same amount of milk production will occur. Therefore milk production stays the same whilst greenhouse gases are reduced. It is not a solution for all farms to just decrease herd size however if herds are analysed correctly and inefficient cows are removed then herd size could be reduced and greenhouse gases would also reduce. This can not only reduce greenhouse gas emissions but also increase profitability for the farmer as they will have lower expenses due to less cows and a better cost to income ratio due to the fact they are not wasting money on cows that do not perform effectively.

(ii) Justify the course of action that has the most significant impact in reducing greenhouse gas emissions, allowing for sustainable production of your primary product.

You should consider environmental, social, economic, and political impacts.

Use recent data (preferably from within the last five years) and other evidence to support your answer.

In terms of supplementary feeding there is large benefits which can reduce greenhouse gas emissions significantly. With impacts such as Forage Rape reducing methane outputs by up to 30% and Asparagopsis up to 50% it is obviously beneficial to the environment as less greenhouse gas emissions means less climate change. In terms of environmental impacts it is going to be overall beneficial as it decreases methane and nitrous oxide emissions. However by planting Fodder Beet and Forage Rape it is going to require more cultivation of the land. It is likely tractors will be needed to plant out these crops which will increase carbon dioxide emission. If supplementary feeds are not grown on farm then they may need to be harvested and transported which also releases more carbon dioxide. Socially this could be beneficial as it would provide more jobs as planting, harvesting and transporting these feeds will require labour and therefore supply employment. In terms of economics this is going to significantly increase production costs of dairy farmers. This is the main downfall to this course of action. Supplementary feeds can be expensive to grow or buy in. Many of these feed do not have other significant nutritious benefits and would not result in an increase in milk production. However it would result in much higher production costs. Therefore it is potentially not viable for a farm to increase their production costs and not their income just to reduce methane and nitrous oxide emission. As it would be difficult for a farmer to supplementary feed due to economic impacts there is potential that policies may be made and enforced to make these changes. There is potential that subsidies may be introduced which may encourage farmers to supplementary feed. There may also be a chance that farmers may look to supplementary feed as political interference regarding carbon tax may make it beneficial. If tax on emissions becomes a reality it may become economically beneficial for farmers to supplementary feed as their emissions would reduce and therefore so would their tax.

In terms of reducing stocking rate this is a much more viable solution as if done correctly has very few negatives. Decreasing stocking rate does not mean decreasing profitability. As if inefficient animals are removed it has the ability to make better profit margins for the farmers. When herd size decreases so do the production costs. If only efficient animals are left then there are going to be less production costs as they are converting less grass into more milk then if there were more animals producing less milk. If strategically carried out reducing stocking rate can be incredibly successful at reducing greenhouse gas emissions as well as remaining profitable. Environmentally this is beneficial as less cows and grass being eaten means less greenhouse gases being emitted. This is also better for the physical environment as if there are less cows grazing there will be less damage to the land as grazing will not be so intense. Politically speaking this aligns well with current political parties as many of them looked to reduce herd size and implement policies to do so. There is potential that policies were going to be put in place in the future to reduce herd size so if farmers are able to make informed decisions before this happens then this is beneficial. Farmers will feel they have more choice on the matter if they are able to see that they can reduce emissions whilst still remaining profitable on their own terms without being forced to do so but political interference. As technology and genetics improve then more and more efficient animals will be in herds which can therefore results in smaller herd sizes with the same profitability. This is why this is the best course of action as it does not effect the farmer economically whilst it still reduces green house gas emissions and is beneficial for the environment.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91532

Total score: 08

Q	Grade score	Marker commentary
One	E8	The candidate explained how both methane and nitrous oxide are emitted in the production of dairy products. They discussed steps that the New Zealand government and industry are taking to help and encourage farmers to reduce greenhouse gas emissions. They identified two viable solutions to reducing emissions and justified the use of reduced stocking rates by explaining how it can lead a more efficient herd with reduced costs. They also explained how it will be more effective at allowing sustainable production that supplements feeding.