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# OUTSTANDING SCHOLARSHIP EXEMPLAR



Mana Tohu Mātauranga o Aotearoa  
New Zealand Qualifications Authority

## Scholarship 2023 Agricultural and Horticultural Science

Time allowed: Three hours  
Total score: 24

### ANSWER BOOKLET

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

Write your answers 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 2–23 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (XXXXXX). This area may be cut off when the booklet is marked.

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

# QUESTION ONE: Reducing greenhouse gases in New Zealand's primary sector

Primary production system: \_\_\_\_\_

## PLANNING

Dairy - Sustainability

Profile

Education - Michael Wang

Perspectives - do as you pay (David Davis)

Trade, Supermarkets, customers - Paris accord 196 countries

22% Dairy

Challenges - 56 Avg AGE, high costs

33b deficit

resilience to climate, could create death spiral





Max points: 1

**Answer**

## 1. Dairy

New Zealand is a nation that is particularly dependant on agriculture for income. 56 billion dollars in export revenue came from agriculture, and milk powder accounted for 11.1 billion of that. New Zealand needs to trade, as our population is 5.5 million, but we produce enough food for 40 million. Therefore it is crucial that new zealand reduces their emissions from greenhouse gases, especially in the agriculture sector, in order for the production to be sustainable and be able to trade. New zealands emissions profile unique, because unlike other countries, New Zealands emissions profile is largely made from the agriculture sector. 48% of New Zealands emissions are from agriculture, compared to China with 14% from Ag, and India with 10%. 22% of all new zealands emissions comes from the dairy sector alone. The emissions from agriculture are composed of 3 main gases, 35.1% is methane, 8.1% is nitrous oxide, and 4.8% is from carbon dioxide. The costs of each gas to their warming potential varies. Methane is 25X more potent that CO<sub>2</sub>, while nitrogen is 300X more potent in their warming affects.

Reducing our emissions from the agriculture sector has become vital, and while persepectives on the issue to differ, the fact is that people are becoming more educated and aware of the issue. In fact, in 2008, 64% of the chinese population believed in climate change. In 2017, this jumped to 94%. China is New Zealands biggest trading partner for our agricultural exports, and with 105 secondary cities larger than New Zealand 'the market is too big too ignore' Nathaniel Keall. Furthermore, the Paris agreement signed in 2016 had New Zealand pledge to reduce their emissions and be carbon net zero by 2050. 196 countries joined the agreement, and this simply shows that countries, and our consumers/markets care about what emissions are produced within our borders, especially on farm. New Zealand was unique, in that we introduced goals to reduce emissions in our food sector, and by 2030 the goal is to reduce methane by 10%, and by 2050 to reduce it between 24-47%. Trade deals are becoming more tight about green house gases, and the clauses against emissions is being used to form technical barriers to trade, to drive up NZ producer costs, and therefore protect their countries domestic producers. The requirments our products have to meet are also influenced by what our buyers, such as supermarkets, want, and how more customers are becoming more aware of the emissions from food production, and they now want more sustainably produced agricultural products.

Reducing New Zealand emissions isn't as simple as just flicking a light switch. Unfortunately, it takes significant cost, research, and education to drive change in the agricultural industry to reduce emissions in the Dairy sector. The Carbon credit scheme is an innitotive that means dairy producers will pay for the emissions they emit from farming, which will in turn significantly drive up costs. The idea of the scheme, is New Zealand buys credits off developing countries with trees to off set our emissions, while also helping these developing countries in the process. What this means is that if Dairy producers don't have practices they can apply on farm, then more costs will occur, and more money will leave New Zealand shores. It is for this reason that the goverment, and local councils have introduced more regulation in effort to try and reduce the emissions from dairy. However, regulation is just the minimum, and our trading partners will keep pushing up the requirements. The centre for climate action have pledged to invest 170 million over the next four years to reducing emissions on farm. 37 million has already been invested into reducing emissions, by funding research. This investment. while large, is critical to pushing our farmers ahead with new technology. The option of doing nothing, while desirable for many farmers, isn't sustainable, because tightening trade deals, and the carbon credit scheme means production of dairy won't be profitable, and money will be leaving New Zealand to pay for our mistakes, not for innovation.

Michael Wang said 'If a person has acess to information, they are more inclined to change'. Educating Dairy farmers is what fonterra, and the goverment need to continue pushing. Producing dairy creates emissions, and Neal Wallace believes '95% of Dairy farmers know their emissions'. But just because they know, doesn't mean dairy producers are actively changing for the better. Farmers need to be educated about the tools currently available, that they can apply on farm, so they can begin reducing emissions and reaching the nations goal or else we will be overtaken by a country that is doing better. The Emerald Isles is catching New Zealand at being the most efficient dairy producers, and Richard Rennie said 'Farmers in Ireland have a better understanding of the sustainability proccessor want'. New Zealand Farmers also need to be aware that regulation is just the minimum, rather the trading partners set the standards of emissions and sustainability. And if these standards aren't meet by some dairy producers, then they fall out of the game. Global warming is a global issue, not a domestic issue, so it makes sense that our trading partners are wanting change in our on farm practices, not just to meet their consumer wants, but also drive up costs of



production. This means farmers need to start using current tools available, and good management practices. Improving the feed quality means less feed is required for the cattle to stay alive, which means less rumination, and less methane emissions. Precision AG, and only applying fertiliser where needed is another solution, because less nitrous it applied. Since 1990, farmers apply 644X more fertiliser today, and don't farm with nature, but rather against it to become more intensive. Production of Milk requires cattle, and some cattle have been proven to produce fewer emissions than others. Breeding cattle that produce fewer emissions, while not a quick solution, is a way to stay ahead of the curve, and meet market requirements. Planting a portion of a dairy farm of trees will help offset emission from dairy, and make net emissions lower, which means less money has to be sent overseas to buy carbon credits. Distribution is another factor of production and is a contributor to emissions, which harms New Zealand's 'clean green' reputation. Electric vehicles, bio fuel in ships, and exporting to closer markets such as China which is 2 weeks away, rather than Europe which is 4-6 weeks away, can help reduce emissions in the dairy sector. While it is more costly to use bio fuel, and adapt new technology on farm, the markets are now requiring the dairy industry to evolve, and reduce emissions.

The investment by the centre for climate action of \$170 millions will enable new tools to be developed, such as methanagen blocker vaccines, rather than dairy farmers to have to innovate all by themselves. But crucial tools, such as Genetic modification, are currently illegal in New Zealand, but if the markets are demanding changes in emissions, and dairy producers aren't receiving a premium for being GE free, then maybe it is time for the rules to change, and for this tool to become available for farmers to implement on farm. As Ian Proudfoot said 'It is time to have an adult conversation' regarding genetic modification.

The average age of a New Zealand farmer is 56. This is posing an issue for New Zealand to reduce emissions from dairy, because older farmers will be less inclined to invest and change because the current farming generation will soon be retiring, and won't want to incur any more debt to innovate, and meet new regulations. This challenge isn't helped by how land costs have rocketed, and young aspiring farmers will struggle to afford a farm and service the debt, let alone also innovate as well. This puts our dairy industry in a tricky spot with reducing emissions, especially methane by 10% by 2030, and 24-47% in 2050. Old farmers won't want to change, and new farmers can't afford to innovate with new tools to reduce emissions. As it is, 6% of dairy farmers are losing money, and if innovation and change doesn't occur, this number will only grow. This means that the option of doing nothing about reducing emissions in the dairy sector will drive out farmers from the industry entirely. While Groundswell certainly have their place for farmers to push back against regulation, the fact is that the global issue of emissions is what is driving the change, and the regulation is simply the minimum. As Andrew Morrison said 'farmers can choose to be the victim, villain, or hero'. While innovation in reducing our emission is crucial, dairy farmers have to be careful to be on the leading edge, and not the bleeding edge, so they are constantly improving, but not stepping too far ahead to fail. *G*

## QUESTION TWO: Growing New Zealand's agri-food exports

Primary production system: Apple

### PLANNING

velocity, value, volume  
 Cam Taler 9% (More risky) 17%  
rising costs, Labour, interest, land, inflation  
 PVRs - false OOR 5.5%  
 Branding  
 AI  
 innovation  
 ↑ Volume  
 top 2%  
 do as you pay, not as you say







Max points: 1

**Answer****1. Apples**

In 2012, the New Zealand government set a goal of doubling the value of Agri food exports by 2025. In the recent election, National also pledged to double current agri exports from 2023, and increase the export receipts earned by the agricultural sector which is currently 56 billion a year. This pledge is done in effort to increase new zealanders standard of living, and help offset the governments 33 billion dollar deficit. New zealand producers of apples need to add value to their products, not only to meet the governments goal, but to stay in business.

Costs of production for apple growers have been increasing for the past decade, due to higher costs of labour, debt servicing, inflation, land, and resources. For the past decade growers have been innovating with new varieties of apples, and better management practices to meet specific market requirements such as colour, size, timing etc. Apple exporters have also switched from the sunset economy of Europe, to the sunrise nation of China, in hopes to target the wealthiest people with the highest valued products. Food safety and bio security is a way apple producers have been able to increase the value on their apple exports over the past decade. China has come to trust new zealand apples, and the rigorous bio checks, and tracability of every apple down to the orchard it was picked from meant that the level of food safety in our apples allowed producers to add value and charge more. The goal of this wasn't to spend a dollar on the cool tracability stuff to simply make a dollar, but rather spend a dollar to make three. The goal of apple production isn't to feed the world, but rather feed that wealthy. These value adding initiatives has contributed to the increasing trade value of agri exports, which now sits at \$56 billion in 2022.

These innovations, while great, need to be kept added to in order to keep growing the value of agri exports. Costs for apple producers keep rising, at a standard 1-3% per year as a guide which is enforced by the reserve bank of New Zealand. However, adding value is becoming more important for apple growers to stay profitable, as costs of production are rising faster than before. Cam Taylor, a apple producer in Hawkes Bay, is someone who is continuously innovating his production process in order to grow the value of his products. But first, why is he, and so many other growers having to add more value? To start, the cost of borrowing is now far more expensive, especially for Cam who operates in the cyclone affected region. Cam pays 9% interest on his debt, compared to 7% pre cyclone because he is now seen as a riskier borrower. The OCR is at 5.5, which means interest to borrow more money is also greater than it was during covid times, with the interest now at 5.9% compared to around 2.5%. The time of candy floss money is now gone. This means more money is being paid for debt servicing, and it can't be used to innovate due to higher debt and borrowing costs. Labour costs are also high, with a RSE worker costing 24.90 an hour, and requiring accommodation, food, and free transport. Land costs are rising too, as urbanisation pushes into rural areas. In the past 6 years, the government and local councils introduced 20 new regulations that people in the agri food industry need to face, which drives up cost and means more money is 'dead' as it is being spent changing things that won't help add value, or increase velocity/volume. When Cam had his pack house flooded due to cyclone Gabrielle, parts of his building that was new in 2021 had to be rebuilt to the 2023 standard, which meant wider walkways, stairs etc. So within 2 years, his 2021 building wasn't upto the new building code, and more money had to be spent with no results of increased revenues. Dead money. It's not just the government that is wanting more regulation, but the bigger growers as well. Apple and Pear represent 320 growers, and they had a conference where Turner and Growers were actively pushing for more regulation. As Cam Taylor said 'we are representing 320 growers, and this increased regulation means small family growers won't be able to stay in the business'.

Part of increasing the agri exports of apples is confidence. If growers don't have confidence in the government, and in production then they will be less likely to invest and innovate, and try increase value. The role of the government is huge in creating confidence, and I found it interesting that Cam said he did better under a red government, but the 'Blue Hue' meant he felt more confident under a blue government. The confidence plays a huge part in growing the value of agri exports, and because Cam was lacking confidence under Labour, he only planted 30,000 new trees a year instead of his usual 150,000. No confidence, and increased costs meant that his plan to cover his pack house in solar panels, which would provide 20% of the power needed, and add value to his apples, never happened. This hindered Cam in his ability to increase Volume, value, and velocity of his apple production and achieve the government goal.



All these increased costs mean that growers have to increase their value of exports to stay in the industry. As Simmon Sinners Said 'it is an infinite game, you don't play to win, but play to keep playing'. But it is a double edged sword for apple producers, because innovation requires investment. But the cost of investment, and production is increasing, and growers are being pushed from both directions. Cam Taylor is using his brand, Taylor Corp, to try and increase the value of his products. He owns three Private variety rights, including the sassy apple, which means he can create scarcity in the market. Taylor, as well as other growers, can't compete with our competitors such as Chile and South Africa on varieties such as Gala, which anyone can grow. Chile don't have a minimum wage, and fewer regulations mean they can produce these common varieties a lot cheaper than New Zealand producers can, which pushes prices down and NZ producers profitability plummets. The PVR's, and scarcity mean that Cam has a unique apple, which he can control the supply for, and because it is different he can sell it for more than a gala apple. PVR's allows the Taylor brand to grow in value. Cam is also trying to squeeze long term costs down, while innovating and adding value with AI. His Pack House is almost fully automated, and even has robotic forklifts that learn through AI. Not only is it innovative, but this technology increases productivity. The packhouse can package a standard 18.6KG Z pack every two seconds, which means that Cam is able to send a greater volume to market with a automated pack house, and in the long term the costs to produce that 18.6kg pack will be less. More Apples in market means more agri exports, and revenue Cam receives.

As Cam said, his apples are targetting the top 2% of wealth in his market, predominantly China. So while China is 'suffering a housing crisis, and youth unemployment is at 21.3%' Neal Wallace, Cam's apples are targetting the wealthy, who will still have money to pay for his premium products. But In order for Cam to sell his apples at a premium to these people, he needs to add value to his brand Taylor. When he meets with buyers, he doesn't put them up in a hotel, but rather lets them stay in his house. When they have dinner, Cam doesn't take them to a fancy restaurant, but rather a meal at the family dining table. This connection with buyers allows him to be more unique, and potentially gain more leverage in the top markets that he is targetting.

Increasing value, volume, and velocity is crucial for apple producers to stay in business as rising costs bite at their heels. Tools in the future have been useful, but new tools now are invaluable for the 320 growers to stay afloat, and to reach the governments goal of increasing agri exports by double. 4

**QUESTION THREE: Primary production profitability and rising costs**

Primary production system (1): \_\_\_\_\_

Primary production system (2): \_\_\_\_\_

**PLANNING**

Dairy - for value, commodity uniform  
 ,  
 H.B  
 adapt, GHG, Maintain NZ image

APPLS

No Plan B







Max points: 1

**Answer**

1. Dairy
2. Apples

The Primary production industry is facing new challenges as the issues of climate change, costs of production, and consumer tastes are changing. Dairy and Apple production are two primary products that are particularly facing rising costs, and needing to evolve and innovate to maintain profitability in production, or else they will fall behind.

The Dairy industry is facing huge regulatory and market changes as the global issue of greenhouse gas emissions is being tackled. The Paris Accord signed in 2016 means Dairy producers, with support from the government and Fonterra, have to reduce methane emissions by 10% by 2030, and 24-47% by 2050. Consumer tastes in our dairy industries target market, China, are changing to consumers demanding more sustainably produced products. Technical barriers to trade are becoming more common, as trading partners want to increase our costs and make domestic producers more price competitive. Producers have no option but to try comply to these new rules, in order to stay in business. This means Dairy producers need to utilise current tools available, such as selective breeding, better feed, and precision Ag, in order to reduce emissions and meet market requirements. But this is easier said than done, because like every industry, dairy is facing the issue of rising labour, debt, land, and investment costs. 6% of dairy farmers are currently unprofitable, so the need to evolve is there, but the means to do it aren't. Centre for Climate Action has dedicated 170 million over four years to develop tools to help make dairy more sustainable. This should open up future tools such as methanase blockers which are being developed, but it is critical that dairy farmers take the current tools, and begin building momentum towards becoming more sustainable and being able to export to our biggest market, China.

Apple production is also facing rising costs, and while the industries impact on climate change is small, pressures from labour, debt servicing, land, investment, and more is causing pressure on apple producers ability to maintain profit and be in the industry. Producers are able to adapt new technologies, such as AI, which will ultimately pay itself off in the long run. Other options include creating a unique product, such as Rockit, which allows producers to create scarcity, and therefore receive higher prices for their good. The idea of creating a brand, and being able to leverage off that brand is a way producers can add value. What Zespri did to gold kiwi fruit, Cam Taylor is trying to do with Sassy apples. Having a unique product, such as Rockit, Zespri, or Sassy will add value to the exports, and help maintain/grow profitability amidst the ever rising costs of production. Changing markets was also a way apple producer maintained profitability in face of rising input costs. Europe is a sunset economy, whereas China is a sunrise. The sheer size of China, and the wealth it holds is too great to be ignored. Cam Taylor now send all his apples to the Asian market, because he was losing income by sending them to Europe. Not only does Asia have a more promising future with all the development, it is also a lot closer to ship apples too. Only 2 weeks away instead of 6 weeks to ship to Europe. This helps decrease costs of production through shipping costs, all while getting apples to market fresher which means they can be sold at a greater premium. Cam Taylor's fruit had zero chemical residues, and this could be favourable for his market he is targeting and gain him a premium. The birth of AI makes production more efficient, and while costly initially, the savings and productivity increase in the long term allows for costs to drop, while revenue rises as more volume is reaching the market.

Dairy is composed largely of milk powder, which is a low value, uniform commodity that is sold on an open market. Milk powder generated 11.1 billion dollars of export revenue in 2021, and is a huge export earner for New Zealand. Producers are now facing a huge increase in costs of production in order to meet market requirements, and achieve the goals set by New Zealand in the Paris Agreement. The issue is, that these rising costs need to be offset by an increase of income. But because milk has to be exported as a powder, it is hard to add any value to the commodity. Fonterra controls 97% of New Zealand's milk supply, so they have some bargaining power with buyers due to the sheer volume of milk powder we can supply. This is both good and bad for the dairy industry, it is good in the sense that Fonterra can try negotiate a better price in the market due to the selling power they hold, and this profit will flow back to the individual producer. But it means that every farmer's milk powder is the same, and no matter the cool stuff an individual farmer does, it won't add value to his product if they are selling their powder to Fonterra, and it means farmers will only be motivated to do the bare minimum. This means that unlike apples, the only way for dairy, and milk powder to gain greater returns is to increase the volume, and become more intensive. But again, this has issues.



Dairy contributes 22% of total emissions in New Zealand, and the use of the current and future tools would decrease methane by an estimated maximum of 47% by 2050. This reduction, if successful, will allow Dairy producers to be able to enter the markets, but the volume they can send won't be able to increase easily. Just because emissions per cattle are less, doesn't mean a farmer can introduce another cattle, as it would simply diminish the progress made. Yes farmers would have more cattle and more milk to sell, but nowhere to sell the milk as they wouldn't meet market requirements. A solution to this is methane inhibitors through a vaccine, but this solution is in the future at least 10 years away from being in practice. While the dairy industry is being pulled from all corners, thankfully the current tools available are simply good management practices. Better feed means more milk. Less nitrogen/fertiliser means lower costs, and better breeding makes for more efficient animals. In the short run then, the tools available to farmers mean they should be able to meet market requirements, while the majority of farmers stay profitable. Unfortunately in the long run, other costs as a direct result of climate change such as more frequent and extreme weather events may mean many dairy farmers lose resources and aren't able to produce and be viable. If steps to reduce climate action don't change in the future, it could become a death spiral, where producers aren't able to afford change, as instead they are spending money rebuilding after more frequent weather events.

Apples are a higher value, unique good that growers can more easily add value too. Cam Taylor with his PVR's mean he can create scarcity, and therefore receive a higher price. Rockit, and the innovation they had made their 'apple' completely unique, and the market had no substitute. With good growing practices, apples can be consistent and the volumes exported to international markets can be high. Mark Ericson, a grower in Hawkes Bay gets a pack out of 90-95% to market, due to good management practices such as rootstock selection, pruning etc. More volume to market means more revenue for producers. Because apples are a fresh fruit, it is far easier to add value too than it is Milk powder. Apple growers will be able to maintain profitability and be viable in production given the current operating environment because of the ability to innovate, increase price received and volumes exported. But unfortunately Cyclone Gabrielle would've caused a loss in profitability for many growers in Hawkes Bay, such as Cam Taylor who lost 20% of his trees and 80% of his crop, and some smaller growers may not be able to recover from these weather events. Again, if climate change keeps creating these events, then apple production will not be viable due to huge rebuild costs. Ultimately both the Dairy and Apple industry need to be able to evolve in order to stay alive, and for the New Zealand economy to keep pushing forward. As Kieth Woodford said 'There is no plan B'.

## Outstanding Scholarship

**Subject:** Agricultural and Horticultural Science

**Standard:** 93105

**Total score:** 22

Q	Score	Marker commentary
1	8	<p>The candidate, for the dairy production system:</p> <ul style="list-style-type: none"> <li>• identified the three relevant greenhouse gases (GHGs) and discussed their relative significance in a concise manner</li> <li>• provided an insightful analysis of the costs and challenges of GHG / carbon mitigation</li> <li>• included the increasing impact of GHG emissions on our ability to trade, the power of supermarkets in this issue, the costs, research and education aspects to GHG mitigation and the issue around the age of farmers its impact on the mitigation / change process</li> <li>• provided a well-structured response and included the production, processing and distribution aspects associated with the identified production system.</li> </ul>
2	6	<p>The candidate, for the apple production system:</p> <ul style="list-style-type: none"> <li>• presented a detailed analysis of the growth of export value that has been achieved over the past decade</li> <li>• included the move to new varieties and markets with a focus on value added opportunities like product traceability</li> <li>• did not link potential for future growth to the role of grower / industry confidence in maintaining growth.</li> </ul>
3	8	<p>The candidate in relation to apple and dairy production:</p> <ul style="list-style-type: none"> <li>• perceptively discussed for both products, the options producers have in order to maintain profitability in the face of rising costs and the future viability of the product and its production</li> <li>• included the increasing role of new technologies like AI within the production / processing system, the ability to create 'unique' products, the role of branding and the ability to grow both profit and volume aspects of production to counter the rising costs with regards to apple production. Weather risks / costs and future viability are also appropriately discussed</li> <li>• discussed the limited options to raise profitability along with constraints that dairy farmers have in implementing the tools to raise their productivity, the problem with milk powder as a low-value product and the constraints that exist to milk volume increases.</li> </ul>