Assessment Schedule – 2023

Scholarship Agricultural and Horticultural Science (93105)

Evidence

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

Score	Performance descriptor from Scholarship standard	Evidence statement	Mark
Outstanding level of performance	*In addition to the requirements for Scholarship level, the candidate will also demonstrate, in a **sustained** manner, aspects of:* • *perception and insight* • *sophisticated integration and abstraction* • *independent reflection and extrapolation* • *convincing communication.*	The candidate: • identifies the relevant Greenhouse Gases (GHGs) • gives a perceptive / insightful discussion / analysis of the costs and challenges of GHG / carbon mitigation • considers production, processing and distribution aspects associated with the identified production system • provides a well-structured, clearly discussed answer, with little superfluous material.	**7 or 8**
Scholarship level of performance	*The candidate will demonstrate **aspects** of high-level:* • *analysis and critical thinking* • *integration, synthesis, and application of highly developed knowledge, skills, and understanding to complex situations* • *logical development, precision, and clarity of ideas.*	The candidate: • identifies the relevant GHGs • discusses in detail or gives an analysis of the costs and challenges of GHG / carbon mitigation • considers production, processing and distribution aspects associated with the identified production system • gives a well-structured, clear answer.	**5 or 6**
Below Scholarship level of performance		The candidate: • identifies the relevant GHGs • provides limited discussion or analysis of the costs and challenges of GHG / carbon mitigation • Some aspects of production, processing and distribution associated with the identified production system discussed • presents an answer that lacks structure and coherence.	**1 – 4**
Nothing meaningful done (including not attempted)			**0**

Sample evidence

- The New Zealand dairy industry contributes 22% of New Zealand's greenhouse gas (GHG) emission profile, predominantly from methane (CH_4) and nitrous oxide (N_2O).
- New Zealand's emissions per capita are the 5th highest in the OECD at 18t carbon dioxide equivalent (CO_2-e) / person / year.
- 90% of New Zealand's agricultural GHG emissions are associated with consumption internationally due to the high export nature of New Zealand primary production.
- Between 1990 and 2017 the New Zealand dairy herd increased by 52%, and nitrogenous fertiliser application increased by 650%.
- Methane is a biogenic gas that is produced from the microbial fermentation due to rumination.
- Dairy cows contribute to 18% of New Zealand's methane producing 2.2 tonnes CO_2-e / cow / year. Methane is 25 tonnes CO_2-e with a global warming potential (GWP) of 25. However, the damage occurs during atmospheric conversion.
- Nitrous oxide is an inert gas, produced due to surplus N through fertiliser or excreta, and then entering the N-cycle. N_2O is 298 CO_2-e with a GWP of 298. Source from urine is 80% and urine is 69% urea. N-fertiliser application has increased from ~20kg / ha to ~80kg / ha.
- A single dairy cow emits approximately 2.74 tonnes CO_2-e / year.
- New Zealand emits 0.87kg CO_2-e / kg of milk solid produced compared to 2.4 kg, which is the global average.
- Regulatory and legislative requirements are likely to further increase as the government becomes more concerned with reducing emissions.
- The sustainable dairying water account has already resulted in 26,000km of waterways being fenced on dairy properties.
- Using less nitrogen fertiliser per hectare or per animal requires careful management of nutrient flows, e.g. using more purchased feed and / or growing forages with a higher yield per hectare and optimising the use of animal effluent.
- Low emission feeds implementation would be advantageous to reduce GHG emissions. Therefore, transitioning away from high neutral detergent fibre (NDF) feeds, e.g. ryegrass, towards more simple carbohydrate feeds, e.g. fodder beet, will result in reduced methane emission. This is due to the digestibility of the high NDF feeds requiring greater microbial fermentation time and therefore emitting a greater volume of methane (~30%).
- It is estimated that if all current good practices were to be implemented then GHG emissions could be decreased by 10%, with new technologies and innovations being required to do this. However, new technologies also have challenges. Breeding for low-emitting animals is projected to decrease methane by 5%, yet it will take at least 20 years to breed the low-emitting trait throughout the New Zealand dairy herd. A methane inhibitor is also an option and is suggested as a way to reduce methane emissions by 30%. However, this is an additional cost, not only of purchasing, but also the application of the inhibitor.
- Nitrification inhibitors slow the conversion of ammonium (NH_4+), deposited into the soil in the form of urine, to nitrate (NO_3), which leaches into waterways. Dicyandiamide (DCD) is a nitrification inhibitor that has proven to be effective in reducing nitrate leaching while boosting pasture growth. However, DCD was taken off the New Zealand market after the discovery of residues in milk. Future options to meet international trade requirements are being considered. But nitrification inhibitors are not cost-effective if the only motivation for using them is to reduce GHG emissions. An application cost between $100 and $250 / ha for a short effective period, a maximum of 6 months, would see farmers spending more than $200 for every tonne of CO_2-equivalent emissions avoided.
- Under the government's 2022 proposed plan (He Waka Eke Noa scheme), by 2025, farmers who meet the threshold for herd size and fertiliser use, will be required to pay a government levy set every one to three years. The price will be influenced by the Emissions Trading Scheme (ETS) and New Zealand's progress to reduce methane by 10% by 2030. Government has said that all revenue will go towards new technology and research. Dairy farmers are thought to have a reduction of 6% in profit from the modelling from the government.
- New Zealand needs to ensure that any new technologies meet all necessary regulatory requirements, such as no residues in milk or meat, and this will be a major test in the development of these technologies.

- CO_2 is largely produced through transport and processing rather than on farm, with Fonterra emitting 1.17million tonnes CO_2-e/year. They have targeted a 30% reduction in manufacturing emissions by 2030, and net zero by 2050. Fonterra estimates $1 billion needs to be spent to reduce its carbon emissions and improve water efficiency across its sites by 2030.
- Fonterra suppliers have an emissions profile to help understand their footprint. 71% of supplier farms have completed their environmental plans, and with the sustainable dairy advisor employed by Fonterra, will develop individualised plans for change.

Question TWO: Growing New Zealand's agri-food exports

Score	Performance descriptor from Scholarship standard	Evidence statement	Mark
Outstanding level of performance	*In addition to the requirements for Scholarship level, the candidate will also demonstrate, in a **sustained** manner, aspects of:* • *perception and insight, sophisticated integration and abstraction* • *independent reflection and extrapolation, convincing communication.*	The candidate: • gives a perceptive / insightful discussion or analysis of - the growth of export value that has been achieved (past decade), and - the potential for future growth (A range of options/considerations are identified and discussed) • presents an accurate, clearly discussed answer, with little superfluous material.	**7 or 8**
Scholarship level of performance	*The candidate will demonstrate **aspects** of high-level:* • *analysis and critical thinking* • *integration, synthesis, and application of highly developed knowledge, skills, and understanding of complex situations* • *logical development, precision, and clarity of ideas.*	The candidate: • presents a detailed discussion or analysis of: - the growth of export value that has been achieved (past decade), and - the potential for future growth (A range of options/considerations are identified and discussed) • gives a well-structured, clearly discussed answer.	**5 or 6**
Below Scholarship level of performance		The candidate: • presents a partial discussion or analysis of: - the growth of export value that has been achieved (past decade), and - the potential for future growth (Limited options/considerations are identified and discussed) • presents an answer that lacks structure and coherence.	**1 – 4**
Nothing meaningful done (including not attempted)			**0**

Sample evidence
• Global demand for sheep milk and sheep milk products is booming. Exports of New Zealand sheep milk products were valued at $20 million in 2020. • Sheep milk is being billed as an export growth industry for New Zealand, with the potential to be worth more than $750 million a year by 2035. • Globally, it is growing by about 20% a year. • There are approximately 16 dairy sheep companies in New Zealand, with the national flock around 20,000 sheep. • Start-up phase was in the late 1990s in New Zealand. • The sheep milk price is around $17.00/kg of milk solids, compared to Fonterra's forecast cow milk price of $9.30/kg of milk solids for the year to September 2022, twice the solids of cow milk, at around 18–19%. • Sheep milk is relatively new, there is a lot of potential, particularly with its alignment to key consumer trends – natural products that are easy to digest for consumers. • Sheep milk is higher in all 10 essential amino acids and has twice as much protein and calcium as cow milk. • It is attractive to Asian markets where milk sensitivity is common. • In 2006 Blue River entered its cheeses in the NZ Cuisine Cheese Awards and won several medals. The company also started trialling powdered sheep milk products along with ice-cream at the Invercargill plant after the sale to Chinese company Blue River Nutrition HK, and it was in 2015 the plant got its MPI and Chinese accreditation meaning that Blue River Dairy has access to the Chinese market. • Spring Sheep Milk won best infant nutrition product at the World Dairy Innovation Awards in 2021. • Since Spring Sheep started in 2015, it has been growing its milk volume by about 70% every year. Sheep produce an average 385 L, with the top performers producing 645 L, with sales growing 60% per year. • The big challenge in the early 2000s was a seasonal supply, where marketing and consistency of supply is important. • The volume of sheep milk products traded between countries, apart from cheese, is not significant. However, the growing demand for alternatives to cow milk products suggests there is scope to develop the market for other formats. Infant formula and nutritional powders offer the best opportunities for New Zealand sheep milk. • AgResearch has suggested dairy sheep could leach up to a third less nitrogen than dairy cows.

Question THREE: Primary production profitability and rising costs

Score	Performance descriptor from Scholarship standard	Evidence statement	Mark
Outstanding level of performance	*In addition to the requirements for Scholarship level, the candidate will also demonstrate, in a **sustained** manner, aspects of:* • *perception and insight, sophisticated integration and abstraction* • *independent reflection and extrapolation, convincing communication.*	In relation to TWO primary products, the candidate: • discusses with perception and insight: - the options producers have in order to maintain profitability in the face of rising costs. - The future viability of the product and it's production • gives an accurate, clearly discussed answer, with little superfluous material.	**7 or 8**
Scholarship level of performance	*The candidate will demonstrate **aspects** of high-level:* • *analysis and critical thinking* • *integration, synthesis, and application of highly developed knowledge, skills, and understanding to complex situations* • *logical development, precision, and clarity of ideas.*	In relation to TWO primary products, the candidate: • discusses fully: - the options producers have in order to maintain profitability in the face of rising costs. - the future viability of the product and it's production • gives a well-structured, clearly discussed answer.	**5 or 6**
Below Scholarship level of performance		In relation to TWO primary products, the candidate: • partially discusses/shows some understanding of - the options producers have in order to maintain profitability in the face of rising costs. - the future viability of the product and it's production OR One production system discussed fully, one not so. • provides an answer that lacks structure and coherence.	**1 – 4**
Nothing meaningful done (including not attempted)			**0**

Sample evidence

- NZ farming systems have become more efficient.
- Expenditure has increased, but the value of products (except for coarse wool), has also increased.
- Improvements in productivity mean that a much greater proportion of the feed is now used to generate production, rather than simply maintaining bodyweight. For lambs, this change has largely been driven by higher twinning rates and much higher lamb carcass weights. For beef, growth rates at the 200-, 400- and 600-day weights, and also quality measures, such as eye muscle area, meat colour and fat colour.
- The cost to produce one lamb has increased by $8.16 / head or 14%.

Sheep and Beef farm revenue

	2009–2010	2019–2020
Wool	$33,000	$32,000
Sheep	$180,000	$309,000
Cattle	$79,000	$162,000

Sheep and Beef farm expenditure – biggest cost is fertiliser

	2009–2010	2019–2020
Fertiliser	$50,000	$77,000
R&M	$23,000	$39,000

- Animal health costs have increased, e.g. shearing, drenching, vaccinating.
- Interest rates during 2020 were at an all-time low at 2.15% in 2021, rising in 2022 onwards, and currently 6.5%, which is having an impact on the profit margin for farming businesses.
- Prices received for lamb increased from 2016 and have been relatively stable from 2019 to 2022 at around $110 per head for YM grade.
- Prices received for steer increased from 2013 and have been relatively stable from 2015 to 2022 at around $5.50 / kg for P grade.
- Beef + Lamb NZ's total farm revenue is up by 4.3% per farm, with the average profit before tax ~$140,000 forecast for 2021–22, an increase by 9%, from 2020 to 2021.
- Increase is driven mostly by the 7.5% increase in sheep revenue, as cattle expected to decrease 2.5% per farm.
- Coarse wool increased by 15%, but still not enough to cover costs.
- Increase in revenue has offset the rising cost of freight, and a strengthening dollar on profits.
- New Zealand's meat supply for sheep and beef held strong during the COVID-19 pandemic and is continuing to do so.
- Demand for high-quality meat cuts is forecast to increase from the USA, EU and UK.
- A big challenge for New Zealand is the urban population does not understand that agri-food systems, from consumers right back to inputs on the farm, are what underpins the New Zealand economy. It is not just about what happens on the farm, but what happens along a value chain leading back from consumers through marketers, processors, and farmers to the suppliers of the farm inputs.

- The long-term future for lamb looks particularly strong.
- If hill-country sheep and beef farming is destroyed, then it is a real puzzle as to what the hill country will be used for. It won't be beef cattle because they face the same or even more environmental constraints as sheep.
- Charges on agriculture emissions, particularly for sheep and beef farmers, would end up costing consumers, e.g. higher food prices.
- These charges will result in decreases in agricultural production resulting from the proposal could be as great 23.6% for lamb and 65.4% for beef, depending on the scenario, says the ANZ bank.
- Farmers need to focus on their export success and maintain hope that a balance between profits and proposed charges for GHG can be achieved. If export prices remain high, there will be an incentive for sheep and beef farmers to remain and not convert to forestry.

Cut Scores

Scholarship	Outstanding Scholarship
14 – 21	22 – 24