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SCHOLARSHIP EXEMPLAR



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Scholarship 2019 Agricultural and Horticultural Science

2.00 p.m. Friday 8 November 2019
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.

Answer ALL questions from Question Booklet 93105Q.

Start planning your answers to Questions One, Two and Three on pages 2, 8 and 14 respectively.

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.

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

QUESTION ONE: SUSTAINABLE PRIMARY PRODUCTION AND CLIMATE CHANGE

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PLANNING

Use this space to plan your answer to Question One:

1. a.) = Fert use \uparrow \uparrow N_2O , Wet conditions
break feeding. Anaerobic conditions
- Change in feeds ~~to become~~ for greater production
Low grain maize silage. NDF
 - High cultivation. Release of CO_2

- b.) - ~~Positive impact~~ Neg impact
- = \uparrow Temp.
 - = \downarrow rain
 - = \downarrow water. Regulations
 - = \downarrow animal health
 - = Driven land use change
- Pos impact.
- = Marketing advantage with
 \uparrow tech to reduce Methane.

Challenges.

- Maintain production \downarrow GHG
- Increased tax. Fert tax
- \uparrow cost of production. Investing
in new genetics.
- Lack of competitive edge.

Begin your answer to Question One here:

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a.) Agriculture has always been the backbone of New Zealand's economy and now contributes to 7% of New Zealand's GDP, second to tourism.

Consequently, this is reflected by the intensive pastoral nature of New Zealand agriculture.

New Zealand is an industry leader internationally which is supported by the 'green' image asset that diversifies New Zealand from other ~~tour~~ more intensive, non pastoral producers such as the United States. Unlike the US and Australia, who thrive on other industries as well, New Zealand has a unique Greenhouse Gas Emission profile due to the largest industry being Agriculture. The profile consists of 44% Carbon dioxide, 43% Methane and 13% Nitrous Oxide.

This profile has come about due to the intensive nature of Agriculture in New Zealand. Due to price booms in dairy in 1990, 2000 and 2010 and recent lamb price booms in 2015 onwards it has recently been extremely profitable to farm in New Zealand with dairy having a 4.8%.

Return on Asset and Sheep & Beef 3.5% Return on Asset respectively. It is this profitability that has driven producers to maximise production of milk and lamb. It is this drive that has lead to intensification and therefore increased production of Greenhouse Gasses.

New Zealand agriculture has an unsustainable fertiliser culture where large quantities of fert synthetic fertilisers are applied annually.

Rates ≥ 70 kg/ha of Urea are applied three times annually on a typical Wairarapa region farm. This use of fertiliser is highlighted by a 650% increase in the amount of Nitrogen applied in New Zealand between 1990 & 2015.

This contributes to New Zealand's Greenhouse Gas Emissions because Urea & similar fertilisers are applied in wet conditions and too often. The result of these anaerobic conditions is that it increases the ~~am~~ rate at which N_2O is released from the soil. This is adverse as N_2O traps 120 times more heat in the atmosphere than CO_2 .

Another way New Zealand agriculture contributes to New Zealand's Greenhouse gasses is through the change in feeds—particularly in dairy. Due to large farm loans and capital expenditure on farm infrastructure, farmers are forced to try maximise production to repay loans etc. In order to maintain production or increase production higher energy feeds are provided to livestock. Particularly with dairy farms, when there is a shortage of pasture supplementary feed such as Low grain maize silage is purchased.

These feeds have increased the amount of CH_4 produced by livestock. This is because—according

to Darry NZ feed values — autumn/winter pasture ~~has~~^{is} 40% NDF per % of DM.

Whereas, Low grain maize silage which is typically feed out in the Haurarapa region has ~~an NDF % of a~~ 50% NDF %.

This increases the amount of Methane belched by livestock because the ~~the~~ finite population of microbial methanogens become overwhelmed by the increase quantity of NDF. Consequently, it takes longer for the finite population of methanogens to break down the additional NDF into Methane resulting in more CH_4 being belched. This is a large contributor to 80% CH_4 in New Zealand coming from livestock. Due to the increased use of and more importantly reliance of supplementary feeds to maximise production.

Another contributor to New Zealand's Greenhouse gasses is the increased cultivation throughout the country. In warmer areas such as Whakatane where arable crops thrive, soil cultivation is extremely prevalent. This ~~increased~~ cultivation is occurring more frequently which results in large amounts of carbon being released from the soil. Whats more is that the average NZ farm is located 54 km away from a Fonterra milk plant. It is this distance that results in greater transport and therefore ~~the~~ large amounts of CO_2 from Diesel trucks.

b.) Climate change presents a large issue to the primary production system of dairy in New Zealand because dairy currently prospers in the ~~temperate~~ temperate climate of NZ. Increased greenhouse gasses are undoubtedly increasing the rate of climate change. NASA has stated that the average global temperature is increasing at a rate of 0.7°C per decade since 1980.

The impact that this presents to the dairy production system is that it will reduce the production capacity.

Unlike other countries, the NZ dairy industry is pastoral with the main cultivar being perennial ryegrass. Increasing temperatures will result in the seasonality of drought like conditions are less rainfall, but more, less frequent downpours.

Increasing temperatures will affect pasture because at temperatures outside of a perennial ryegrasses optimum temperature or $\geq 33^{\circ}\text{C}$ increased plant leaf death is observed. Thus the impact of increasing temperatures is that crop yields will decrease, decreasing the quantity of pasture available for dairy stock to eat. Therefore kg/MS production will inevitably decrease. Nonetheless, increased temperatures will decrease the availability of water for irrigation and livestock water. Less water availability and therefore increased water regulation will make dairy farming in areas such as the Canterbury plains — where irrigation is necessary — simply unfeasible. Additionally, decreased

stark water will adversely affect milk production. Lactating dairy cows require an additional 85-90% water intake daily to maintain milk production. Therefore kg/MS production will decrease reducing the profitability of dairy farming in NZ.

A positive impact of the impact of climate change on the production of dairy is that it will encourage the innovation of new hardier, more drought tolerant cultivars which will challenge New Zealand's GMO free policy. What's more is that it will encourage new variable rate irrigation technology so that there is maximum utilisation and minimal wastage of irrigated water as it becomes a scarcer resource.

Therefore, the challenges producers face is trying to reduce the amount of Greenhouse gases produced to minimise & draw out the effects of climate change. The main challenge of this is to maintain or maximise current production of kg/MS. Tests in NZ have shown that sheep fed exclusively on Forage rape in winter produced 38% less CH_4 . Given cattle are also Ruminants it would be expected that cattle would have similar results. However, the challenge of this is that it is difficult to implement nationally provided there is currently no financial incentive to have a lower CH_4 emitting herd. Additionally, feeding Rape exclusively may taint milk which would result in lower per kg/MS prices. Decreasing the profitability of dairy farming.

QUESTION TWO: CONSUMER PERSPECTIVES WITHIN THE GLOBAL ECONOMYASSESSOR'S
USE ONLY**PLANNING**

Use this space to plan your answer to Question Two:

- 1.) - Pure green image driving demand for natural grass products. Unlike feed lot etc
- Want convenience. Butterfied leg
- Asian market. New hen beef crockpot, tender - lean.

Begin your answer to Question Two here:

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Consumer perspectives have always guided innovation in the industry and dictated the production and way NZ primary products are marketed.

Lamb in particular has been guided by consumer perspectives. Particularly, the Asian and US consumer demand an ethically produced lamb product which is both aesthetically and tastefully pleasing. To take advantage of this, Beef and Lamb NZ has created the 'Pure NZ' image and brand for the USA. This marketing involves highlighting the natural, grass fed aspect of New Zealand agriculture. The true monetary value of the New Zealand agriculture story was highlighted by 'Icebreaker' selling 'VF cooperation' the rights to use New Zealand imagery and wool story for an outstanding price of \$288 million. The monetary value would absolutely be similar for the lamb protein. Consumer trends have swayed in that consumers now want a more ethically produced product that is caring for the sustainability of the environment. Fortunately, it is already known and perceived by international consumers that American feed lots and the similar likes are not ethically produced lamb products. This has guided innovation in marketing because Beef and

lamb can use New Zealand's pastoral asset to its advantage. This is because modern consumers desire an emotional connection with the product they are consuming. By Beef and lamb marketing a story, consumers can connect with the New Zealand story. By being exposed to this story consumers will perceive New Zealand to be producing lamb in a natural and ethical manner and thus be more likely to purchase New Zealand lamb over competitors like the USA and Australia.

However, to market and advertise this image the on farm practices have had to remain of highest ethical standards. For example, backlash occurred when animal welfare organisation P.E.T.A published content to the media regarding mulesing in New Zealand agriculture. Although it was a common practice, consumers were simply unaware. It is issues like this that have the potential to damage New Zealand's lamb competitive edge. Because unfortunately, consumers have the buying power and will simply purchase from other producers. Despite on farm practices being superior in terms of ethics and natural production, New Zealand lamb cannot be charged at a premium price because the price of lamb is elastic. If consumers cannot afford lamb they will purchase Australian lamb for example. Or even be more

persuaded to purchase cheaper protein alternatives
Overall, New Zealand's image and story is
it greatest asset.

QUESTION THREE: CHANGES IN LAND USE IN NEW ZEALAND

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USE ONLY

PLANNING

Use this space to plan your answer to Question Three:

	Dairy	S+B
Economic	<ul style="list-style-type: none"> - Dairy booms - More profitable 	<ul style="list-style-type: none"> - Forestry. More profitable per hectare - \$1500/ha > \$1200/ha
Social	<ul style="list-style-type: none"> - More intensive published on media - Backlash. - Mental health - 25% more likely. - Rural/Urban divide 	<ul style="list-style-type: none"> - Icebreaker - Perceptron. \$288 mil - 70% of maori land
Environmental	<ul style="list-style-type: none"> - More intensive - Eutrophication 	<ul style="list-style-type: none"> - ↓ erosion - ↑ biodiversity

Begin your answer to Question Three here:

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Sheep & Beef. In the mid 1980's the newly ~~electly~~ elected Labour removed the Livestock incentive scheme and its surrounding subsidies making farming in the early 1990's extremely unprofitable. As a result many farmers planted marginal class 5-7 land into forestry blocks. It is now that these blocks have reached ~~there~~ their 25-30 year lifespan and investment horizons that their economic value is being highlighted. These blocks are now earning a revenue at harvest of \$50,000 to \$70,000 per hectare. It is this profitable revenue that is convincing farmers to plant more areas into forestry. Alternatively, ~~the~~ ^{another} economic implication of this land use change is that these 1990 blocks, as part of the ETS are now and will be more profitable per hectare. Sheep & Beef farming currently returns \$1500/ha. Currently, one unit of CO₂ equivalent has a return of \$1200/ha. With the certain increase of Carbon sequestering about to occur, the unit price of CO₂ equivalents ~~but~~ is estimated to increase to \$200 which will boost greater profitability of Sheep and Beef with far greater profitability of \$1500/ha. ~~It is~~ The implication of this land use change is that it has flicked the switch for ~~at~~ Corporate business looking to sequester & offset their Carbon. And Kiwi farmers are selling land to receive the premium prices per ~~hectar~~ hectare compared to sheep and beef

farming. This complex implication has recently ~~seen~~ caused or encouraged the sale of 18,000ha in the Wairarapa & Tararua region be sold and destined for forestry. The implication of this is that it may well, under law, land lock the land which will prevent this land for being used for anything else other than Carbon sequestering.

A social implication of the land use change ~~is~~ ~~that~~ from Sheep and Beef to Forestry is that it has damaged local, rural communities. For example, the sale of 'Hadleigh' station in the Wairarapa region has come with great controversy and upset. The sale of large, historic or locally significant farms has resulted in a loss of local identity for rural communities. Not to mention, this land use change results in a reduction of labour and therefore families. As a result, local communities suffer at a decreasing population affects the local economy. It would be expected that the general standard of living also decreases.

The environmental implication of this land use change is not all negative. The planting of forestry trees and even indigenous trees has encouraged and fostered biodiversity on farms. Also, an implication of the land use change is that the ecological and topographical benefit of trees on marginal hill country class 4-7 outweigh the

economic return. Trees have reduced rates of erosion on steep topography which once would have been very prone to erosion from livestock. This reduced erosion over the past 20-25 years has reduced the amount of soil depository in waterways which reduces the rate at which Eutrophication occurs.

Even more simply, an implication of this land ~~Dairy~~ farm use change is that increased tree populations will result in a greater quantity of CO_2 being absorbed from the atmosphere. This will undoubtedly contribute to mitigating the harmful affects of Greenhouse gasses and ~~subt~~ subtly benefit New Zealand's NDC to reduce Greenhouse gas emissions 30% below 2005 levels as per the Paris Agreement 2016.

Dairy farming. Economic implications of the land use change from dairy to even more so intensive dairy have resulted until recently, great returns for dairy farmers. Later after the dairy price boom in the early 2000's the GFC occurred in 2008 which saw ~~so~~ a significant amount of dairy farms be sold at extremely low prices. Neighbouring farmers who could afford to purchase in the midst of the recession experienced the benefit in 2010 when the farmgate milk price increased to \$8/kg/MS. These farms were now larger in area and capable of intensifying. The implication of this is that until Fonterra just recently reporting a loss,

dairy farming has been extremely profitable. Another land use change involving dairy that has occurred is New Zealand's rapidly growing population.

The population is estimated to reach 8 million by 2070 and 100,000 ha to 200,000 ha will be required for urban development. This urban sprawl is seeing valuable, fertile dairy land be sold for lifestyle blocks and subdivisions with the ideal 'large garden'. The implication of this is that it is ~~putting a~~ increasing the price of farmland. Lifestyle blocks are now worth \$97,000 per hectare whereas similar farmland is only worth \$23,000 per hectare. This is increasing the value of farmland making it harder for new farm owners to enter the industry.

The land use change for dairy that has occurred is that existing dairy farms have become more intensive with the implementation of genetics, use of fertilisers and increasing stock numbers. Unfortunately, this intensification has harmed the environment through leaching and increased greenhouse gases. More unfortunately, publications have been made on media showing the explicit and most extreme damaging affects of dairying. As a result, dairy has gained a stigma of 'dirty dairying' which has caused particularly urban people to boycott the dairy industry creating a lot of backlash. The social implication

of this is that it has caused NZ dairy farmers to feel undervalued. Wairarapa sheep & beef farmer Sully Alsop wrote "You feel like the whole country has turned their back on you". This is a perfect example of how saturation of backlash and regulation is damaging farmers' wellbeing. Mental health has become a major problem in rural communities and sadly rural people are 25% more likely to commit suicide than urban people.

An environmental implication of the dairy land use becoming more intensive is that the biodiversity of waterways has suffering. Populations of native fish are decreasing as a result of increased run off and nutrients. For example, the population of Freshwater crayfish throughout NZ was 5% lower in 2018 than it was in 2017. Additionally, compounded with decreasing water levels in rivers etc the nutrients and run off of dairy farms is extremely more concentrate in a smaller volume of water. Thus exponentially increasing the damaging affects of Eutrophication which also limits stock water use and recreational use of the water.

Scholarship Exemplar 2019

Subject	Agricultural and Horticultural Science		Standard	93105	Overall score	13
Q	Score	Annotation				
1	5	The candidate has presented a well-structured, articulate and insightful response to the question. The three main agricultural greenhouse gases are identified and explained with accurate and appropriate data. The impacts of climate on pastoral dairying are clearly discussed, including potential positive impacts, and the challenges the wider dairy industry face (e.g. innovation being hampered by such things as a lack of incentive and limitations due to the pastoral nature of the farming production system).				
2	3	While the candidate has presented some relevant discussion, the answer lacks the depth that a higher mark would demand. The marketing of New Zealand's 'image' with products like lamb and Merino wool and the place of ethically produced produce are discussed, but the link to innovation is weak and is a key factor in limiting this answer to a sub-scholarship mark.				
3	5	<p>The candidate has chosen dairy and sheep and beef. Technically, sheep and beef are two separate production systems and the answer has been considered accordingly.</p> <p>The land use changes for both dairy and sheep / beef are discussed with the impact of forestry, carbon farming and the ETS providing the context for some sound discussion of the relevant implications to the sheep / beef production system. Social, environmental and economic implication are discussed.</p> <p>The dairy expansion has been discussed with some relevant data and a range of sound implications that include all three aspects (environmental, social and economic).</p> <p>Overall a scholarship level answer – 5.</p>				