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OUTSTANDING SCHOLARSHIP EXEMPLAR

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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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

Agriculture is part of a complex economic, environmental and social system. It underpins economic development and poverty alleviation globally. Long through the 20th century it was considered the back bone of the New Zealand economy, driving our export trade. The dairy industry has been at the very heart of New Zealand economy - internationally and nationally the environmental affects of greenhouse gases are posing great challenges for this industry. It now faces a deadly challenge.

Greenhouses gases – by products of dairy- are components in the atmosphere, as the sunlight passes through, these gases allow the suns energy to reach earths surface. However, these gases prevent some of this energy from escaping – creating a warming effect. As concentrations of greenhouses gases increase, there is an increase in the global greenhouse case effect, to be what is defined as climate change. Greenhouse gas emissions are creating this effect, which is shifting earths energy balances, leading to potentially detrimental issues. These include severe weather patterns such as droughts and floods. The main agricultural greenhouse gases in NZ are Methane and Nitrous Oxide, accounting for 54% of our emissions, with Carbon Dioxide making up the rest. Greenhouse gas emissions have been on the rise and have increased by 130% since 1990, rising from 700 parts per billion to 1745 parts per billion. As the population rises and the demand for food increases agricultural systems are put under more pressure to produce food in a way that reduces negative environmental impacts; dairy stands to be affected.

One of the most visible manifestations of intensification in New Zealand is that of the dairy sector, the number of cows per hectare increasing significantly – from 3.44 million in 1997 to 4.99 million in 2018. The dairy industry underpins a larger section of our very society today, being 28% of New Zealands export trade. Dairy cows are the largest greenhouse gas emitters – equating to over 40% of specifically agricultural emissions. This industry accounts for $15.1 billion per annum; 95% of our dairy products are exported, often to high quality markets. Despite only accounting for 6% of the global dairy production, our exports make up about 30% of all exported dairy products – considerably a huge factoring in the size of our nation and the location further away from these markets. Our main export for dairy is China, United States, United Arab Emirates and Japan – all emerging economies with high potentiality. These middle-class growing economies provide severe opportunities for New Zealand dairy trade and stand to be impacted by the greenhouse gas emissions. At the United Nations Paris Agreement, New Zealand decided to aim for 30% reduction in 2005 greenhouse gas emissions by 2030 and a further 50% of 2005 levels by 2030. Methane is produced in large quantities by cows, this is produced in a process called eructation, where methane is burped out due to the ruminant qualities of the dairy cow. Climate change as a result of greenhouse gases stands to negatively impact not only the dairy industry itself, but the deep roots it holds in our very society. It is expected that with the current need for 35% reduction in methane, dairy farming profitability will decrease between 7-70% by 2050, posing very realistic risks to our export trade. Some opinions have arisen that dairy farming should be replaced by forestry; forestry can act as carbon sinks and many people believe this is the infinite solution. However, Simon Upton argues that forestry cannot be regarded as a permanent issue, not only does it pose very realistic risks of disease and fire, it stands to be impact by climate change itself. Despite contrary belief, the solution to our issues is not necessarily to plant trees everywhere.

Simon Upton argues that the three contributing gases need to be separated and dealt with according to their atmospheric life conditions. Carbon dioxide is the most abundant force, being the main driver of climate change. As mentioned previously methane is produced through farting and burping of cows, Carbo Dioxide is produced through the burning and use of fossil fuels, and nitrous oxide is produced through excess nitrogen fertilizers and urea being broken down by soil microbes in the

nitrification cycle. Carbon dioxide is 300 times more abundant than methane and 1000 times more abundant than nitrous oxide. With the current goals to reach climate change, this idea needs to be factored in before blame is heavily directed into the dairy sector. Methane is the largest emitter from dairying, yet has the shortest atmospheric life of 12 years, whereas Carbon Dioxide accumulated indefinitely. Biological gases such as methane, with new research discovered, can be mitigated to a net goal, by leveling out the emissions, instead of reducing to zero. Undoubtedly, there are many aspects of dairying that can be improved in New Zealand; some farmers are naturally doing more than others, an effective baseline needs to be met – however is it all their fault?

The inequity of the rural sector in response to the rapid changes needed to be addressed was acknowledged by a member of the ICC. The dairy sector is suffering huge blame and accusations for members of urban communities and governments, however there is only limited technology available to mitigate greenhouse gas emissions. Methane injections and low emitting feeds are all being researched, but these technologies may not be on the market for another 2-10 years depending on laboratory trials. Even with this technology, it may not work for the New Zealand system. A Dutch company has begun trials for a supplement that reduces belching in cows, thus reducing methane emissions. Extensive trials of these have shown this could reduce methane emissions by 30%, however, this was based of high intensity farms globally. In reality, due to the lower intensity of dairy farming in New Zealand, this translated to a 5-6% percent effectiveness for reducing methane. Our country produces 10% less emissions than other developed countries, while we account for 15% of all globally emitted methane. NZ dairy sector is in a tricky situation that climate change presents.

Simon Bridges says that there is a current lack of options for mitigation, meaning the likely behavioral change that will come will be culling of herds – to reduce stocking rates and thus gas emissions. However, any drop-in production here is expected to be picked up internationally, in countries where taxes or consequences of greenhouse gas emissions are imposed. Through penalizing farmers in New Zealand, means that we will be affecting their stocking numbers and local profits, meanwhile their loss in productivity is being compensated elsewhere internationally. Federate Farmers have long argues that factoring in a tax, under the Emission Trading Scheme for farmer, will just be picked up by another country who is not doing their part to protect the environment. Ultimately imposing harming and costly regulations onto our dairy farms could be counterproductive, being worse off for climate change and NZ international export change. With global populations on the rise the demand for dairy products is expected too rise to 900 million tones, despite the affect of dairy on the environmental, it feeds a total of 100 million people, in the form of milk powder, cheese, butter, infant formula and more specialist products such as casein and proteins.

"Gradual rather than incremental change needs to be managed to meet these climate goals" Vivid Economics engagement manager Alex Kazalgis says. It is going to be costly both socially and economically to impose sudden restrictions to the dairy industry when it does contribute such volumes to the export trade, counting for 1 in every 3 NZD export dollars. There seems to be no evidence of effective policies that can monitor and manipulate shifts in global diets, if anything, there seems to be prevailing trends that the demand for livestock products is increasing rather than decreasing – despite alternative protein sources being developed. Following this upward growth trend of population and demand for food, dairy farming can be made more effective. This can come in the form of an accumulation of small changes. Through changing feeds, stocking rates, increasing productivity per cow, reducing the use of imported food, and planting 20% of farmland areas, the sector can take a step in the right direction. Positively, the government can work closer with farmers

– as it was shown 98% of farmers did not understand the amount of greenhouse gases emitted from their properties – collective change can come.

No doubt – dairy farming contributes to New Zealand's greenhouse gas index by producing large quantities of climate warming gases. However, located in a complex situation within our global economy dairy farmers should be encouraged to be taking guardianship of the resources. Short term impacts, such as a lose of profit in introducing gradual mitigation changes can affect producers, although, long term we may be putting our whole rural sector in danger if we do not make some changes now. As New Zealand, we need to incur the short term loses of climate change to minimize the long term impacts which could very well destroy our economy and the lives of the 40,000 people employed in the dairy industry.

Question Two

Consumers dictate our every move. New Zealand relies on its high-quality export trade to make a profit. Consumers base their buying off their values and beliefs. Our country has tapped into many high quality and emerging markets, which provides a real gap to utilize out "Clean, Green Image"' to target premium markets. As the consumer perspectives change globally, being so heavily reliant on the primary sector New Zealand must constantly be adapting and innovating.

One of the most successful New Zealand innovations came in the form of a small gold fruit. Zespri developed the global success of the golden kiwifruit. China is one of our highest quality markets for kiwifruit, and this New Zealand company saw the high potentiality to tap into the consumer market – by listening to these perspectives. Zespri saw a huge demand for a sweeter product in this market. The upward sales in kiwifruit were seen to be a result of the Chinese culture of "tiger mums." This consumer values provided influential into the development of the Gold Kiwifruit. In China, during the heightened gold kiwifruit season, gold kiwifruit can be sold for up to $3.30 for one piece of fruit. The consumer demand for sweeter fruit set Zespri to work, responding to the consumer market, hundreds of people were involved in the innovation of this fruit, which has proved to be a great success. The Gold Kiwifruit achieves dramatic premium prices within the Asian market. Zespri produced a small fruit that reached a higher brix level of approximately 11-12 Brix when Green Kiwifruit capacity is about 8-10 brix. Consumers drive the very market we export, providing it vitally important to be consistently thinking innovatively to ensure long term profitability for the New Zealand Economy. Zespri has displayed great commitment to innovation, constantly researching and brainstorming ways in which their products can benefit consumers in a global situation.

Utilizing innovation, new market opportunities can open up. Due to the location of New Zealand, being so far off main export routes, New Zealand products need to stand out and have a competitive edge, we need to rely on niche rather than commodity markets. Globally, New Zealand has a good reputation for high quality in large markets such as China. Zespri exports 3 million kiwifruit trays over to China for golden week, 33% of our beef exports go to China – just this year reaching the $1 billion margin, large amounts of our dairy products go to China. Consumer perspectives and target market trends have been a key unique point that New Zealand has tried to target. We are insignificant compared to export markets like United States, but we can place our foot in high quality markets by being seen to be adapting and innovating to suit market needs.

Societal and environmental implications are driving New Zealand and consumers to respond in new and innovative ways. With sustainability being a key consideration and ever increasing decisions when consumers purchase products, New Zealand's products need to stand out on the shelf. This country is a relatively low emitter and clean country compared to other high intensive farming, in countries such as the United States. As social and environmental impacts of farming become more prevalent in consumers globally, companies such as Fonterra need to innovatively think of marketing strategies which can use our clean environment to it's advantage. With cattle related products reaching volumes of $19 billion per year, more innovative marketing has aided in the value added products we sell today. Packaging for New Zealand products have been utilizing the environmental perspective of consumers, but heavily drawing on the fact New Zealand farms largely grass fed. United States farms mainly on intensive systems, where cattle may never be on pasture. United States is competing in similar markets we are competing – and we need to set ourselves apart. Taupo Beef and Lamb for example, due to the increased concern of farming impact on waterways, developed a premium pricing and marketing strategy that targets high end restaurants and markets globally. Mike and Sharon Barton adopted a marketing strategy that highly promoted the "grass fed" attribute of the beef. Using specifically green coloured and distinctive branding and packaging, they

were able to channel their products into high quality global economies. Concurrently, they have been working to achieve what is called an environmental tick, a strategy and promotion technique that indicates the businesses support of the environment, helping these products to have a high value place in the global markets. Marketing is the first thing the consumer sees. It is the immediate presentation of the product that can determine whether New Zealand can be successful within global markets. Fonterra and other beef producers such as ANZCO, Afco and Silver Fern Farms have lent more towards new marketing and packaging ploys that promote the clean, green and grass fed image better.

As the global population rapidly approaches the 8 billion margin, sustainable production is being increasingly driven by consumers. Sustainability of food production system are becoming an increased focus globally. New Zealand has been guided by the consumer concern that eating red meat may not be economically or environmentally sustainable. The effects of farming on waterways, soils and the greenhouse gas emissions are driving New Zealand's innovators to develop solutions. Alternative proteins such as cricket powder and lab grown meat are being guided by the consumer perspective that we as a nation need to minimize our effect on the environment, simultaneously working in a way that promises food security. Innovators recognized a need for a more efficient and cheap alternative – driving the alternative proteins. Although, these products are a long way off being huge global success, some of these products are seen in our local shelves. "Chicken less Chicken" can be seen at NZ supermarkets, being a protein that was developed with chickpeas, to mimic the protein of meat but minimize the negative effects of such produce. This is not to say, that in 50 years' time, our beef market may have significantly dropped and high end exports of alternative proteins are shipping out of our docks in thousands of tonnes.

Innovation isn't necessarily a direct change to a product, but it can be innovation right here at the beginning of the primary process that can be driven by consumers and therefore impact products within the global economy. With the environmental pressures of farming, New Zealand has seen a 15% productivity lift in dairy cows in the last 30 years, due to the new technology and science that helps to minimize the effects. For example, better educating farmers on the best feed types to maximize productivity and new plants they can grow with less negative impacts on the environment, can simultaneously impact productivity, profitability and consumer perception. Consumers at the end of the supply chain have largely guided New Zealand's companies in terms of their final product, however consumers are coming more aware of the production line and the stages along it. Traceability is becoming more important – especially with food related products. Increased transparency along the lines can benefit New Zealand on the global economy as innovations to production processes are admirable and of higher quality. Consumers can drive the way products are produced, such as campaigning for lower environmental footprints, allowing a more niche market which New Zealand products can utilize.

In conclusion, New Zealand is too small and too far away to be a huge commodity producer. By listening and shaping our products to the consumer trends and demand curves, we can match supply of high quality goods. The global economy is a complex system, with many attributes that could help NZ thrive, but alternatively destroy us as a nation. However, through understanding consumer perspectives we as a nation can target the high quality global markets which will give us the highest returns, situating our small little country well in the global economy.

Question 3

Driving from town to town, rolling fields of green grass, lie abundant in the New Zealand landscape. Abundant – not so. 36,400 hectares of market gardens have been consumed by urban sprawl. Beef farms are being converted to forestry. Land use changes have been inbuilt in society; land changes, it has been fine until the last 20 years. New Zealand faces many economic, social and environmental implications with changing land use systems. Celery and beef are victims, being swallowed up and spat back out as houses and trees.

Horticulture NZ CEO Mike Chapman says that if we are to tackle all the environmental issues surrounding New Zealand, land use changes need to be effectively considered, so that our most elite and prime soils can be protected. Celery is a product that was previously abundant in the Auckland Bombay's, however, this system has seen issues from pressure by urban development. 30 years ago Auckland once consumed 0.3% of the most elite soil – now they consume 30% and this is rapidly advancing, as approximately one million houses are in the process of being built over the next 10 years. This pressure has been insurmountable for many celery producers. New Zealand produces about 85% of their own fruit and vegetables, this is expected to reduce to 20% by 2030 if the trend of the last twenty years is to continue without effective protection of elite soils. Economically, this is detrimental to our country. Although it is vital to consider the increasing population and where they will be housed – it is equally important to protect food production capabilities of such soils. The Land Class System has class 1 to 8, measuring the suitability for different uses of the land. Crops such as celery, thrive on land between class 1-4, making up our elite soils. Celery and vegetable products alike cannot thrive in lower quality soils, so it is not as easy to tell them to "move somewhere else." Only 5% of New Zealand soils are elite soils, and almost all our commercial vegetable growers require such soils. In the last 20 years market gardens have decrease 30% by almost 70,000 ha. This shift in land changes and urban development is coming at a time where food production systems are under lots of pressure to minimize their environmental footprint.

In the last few years, both international and national buyers have been sucking up much of our prime beef land. Farm prices are buoyant but the $25 a tonne incentive for carbon credits has dramatically shifted the land use changes in New Zealand. Blanket forestry changes are being seen among many districts in New Zealand. Environmentally, forestry can be helpful due to the capability to act as carbon sinks, however the socio-economic effects are being largely misunderstood. Currently, due to the price of carbon and the potential that this will rise, beef farming cannot compete with this industry in terms of profit. Beef and Lamb NZ commissioned BakerAg to report on the socioeconomic effects of forestry conversions in the Wairoa district. This report confirmed Beef farms could not compete economically with forestry. The average return for forestry in the region was $637 per hectare, while beef was an average of $212 per hectare. There was a notable difference in profit, largely to due to the past few years which have introduced the concept of carbon credits, allowing for an earlier accumulation of profits, compared to 50 years ago. Beef produces $3 billion worth of revenue into the NZ economy and this is expected to rise to 4.17 billion in the 2020 season. Due to the potential impacts of forestry and the reduction in beef farms, New Zealand stands to be economically impacted.

BakerAg further investigated the more specific effects for Wairoa community with afforestation happening at such an alarming rate. The beef industry was set apart from forestry due to the ability of it to create a wider and more abundant range of jobs, the products and services required did not change much year on year, allowing a steady job market to be built around the sector. These jobs provided a much larger array of products and services than that of forestry. Not only do farmers stand to be impacted by the afforestation, but indirectly places like vets will be affected. It was

shown that forestry required an average of 2.2 local jobs per 1,000 hectares per annum, while sheep and beef required an average of 7.4 local jobs per 1,000 hectares per annum. This provides social implications due to the loss of jobs in the area. Land changes can destroy communities. Economic implications also occurred as a result of less jobs and families having to move, as 23.5 million less was spent in the local economy – due to forestry – this has a dramatic effect on small rural towns. Forestry is forcing communities out. Schools in rural towns found a record drop in school enrolments, and the overall economies were reducing.

Economically, many aspects of the rural sector stand to be impacted by urban sprawl. Both beef and market gardens are facing rising costs of productions. As urban centers get closer and closer to these primary production systems, farmers are facing a severe increase in rates. In New Zealand, land is valued by the highest capability or use of the land, therefore farms who are closer to residential areas face valuations that define their lands value as a subdivision. This value can affect farmers as they can face much higher rates, in the Bay of Plenty, in areas like Rotorua, farmers are facing rates of up to $50,000 per annum. A farm closer to the urban center will be paying higher rates than farmers that are located further out. This creates a sense of competition within our beef and vegetable sector – instead of working together to collectively supply the city. Furthermore, it creates inconsistency across the board and can create challenges in profitability, as farming can come unprofitable due to the pressure of housing. Alongside the economic pressures of residential areas closing in on farms, social pressure comes to. There has been conflicts with neighbours complaining of noise from onsite practices and smells from fertilizer application – this is making it all the more harder for these producers to survive. As a response to these pressures' celery farmers are moving further away from cities, which not only presents issues of incompatible soil types but also a restriction of transportation.

Long term the view of our land use is important when considering the economic, social and environmental impacts. Kaitiakitanga is a Maori concept that involves taking guardianship for our natural resources, protecting our natural environmental systems should be vitally important for considerations of land use changes. Short term, economic benefits need to be equally considered alongside the long-term environmental effects. Farmers, both in agriculture and horticulture have been seen to take a more intergenerational approach to uses of land, over foreign forestry investors or urban planners. Our primary sector is known for the perspective that farms need to be long sustainable in the future so that many generations and communities can benefit of their products. In converting beef to forestry, there is no going back. Once the land has been converted it can never return to its original and higher-class state. Forestry sucks up large percentages of the richness and fertility in the soils, having long term implications. Similarly, through converting market gardens to urban cities, these elite soils are being covered by tar, bitumen and concrete, being unable to ever go back to the high-quality land it once was. Once converted, never going back. The long-term restrictions of land post forestry and housing should be considered when land use changes are imminent. Kaitiakitanga of the land needs to be adhered and uplifted.

In conclusion, New Zealand's food production systems are at risk, if more careful management of our natural resource land is not implemented. Despite the lush rolling green country sides we see driving from Cape Reinga to Bluff, we are in danger. In danger of economically, socially and environmentally impacting the nation. There is a balance to be achieved with these three key concepts and it is vital that careful consideration of land use changes in NZ occurs. We need to think smart.

Outstanding Scholarship Exemplar 2019

Subject	Agricultural and Horticultural Science	Standard	93105	Overall score	20

Q	Score	Annotation
1	7	The candidate has presented a well-structured, articulate and insightful response to the question. The three main agricultural greenhouse gases are identified and explained. The impacts of climate change on dairying are clearly discussed and the challenges the wider dairy industry face are analysed in detail. A number of relevant perspectives are referred to. A coherent and effectively structured response. A couple of small inaccuracies were the reason for a 7 and not an 8 being awarded. An outstanding level answer – 7
2	6	The candidate has presented a very through response – initially discussing the role of Asian / Chinese consumer perspective in the breeding, development and marketing of the gold kiwifruit variety. Societal and environmental drivers are explained and differentiating New Zealand beef production from the intensive practices of countries like the USA within the marketing and branding of New Zealand beef is clearly articulated. The potential of alternative protein sources is mentioned and the point that innovation can occur throughout the entire production / marketing chain is effectively explained.
3	7	The implications of land use changes have been recognised and perceptively discussed. Celery / vegetable production in the Auckland region and beef production in the Wairoa district have been specifically discussed. Social considerations such as kaitiakitanga, urban-rural tensions and intergenerational thinking of farmers allow for perceptive comment and the need to balance environmental, social and economic considerations is a tidy conclusion. A well-structured, clearly discussed answer, with little superfluous material.