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93105A



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OUTSTANDING SCHOLARSHIP EXEMPLAR



NEW ZEALAND QUALIFICATIONS AUTHORITY
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Scholarship 2022 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.

Answer all THREE questions from Question Booklet 93105Q and 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 (☒). 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	Score
ONE	
TWO	
THREE	
TOTAL	

QUESTION ONE: Factors impacting the sustainability of New Zealand agriculture

Primary production system: **Dairy (milk)**

PLANNING

Environmental impacts - Freshwater nitrate levels 11.3mg/L
625% Nitrogen increase lake level since 1990

Irrigation - 3% of NZ
70% of that in Canterbury
Farmland not designed for dairy to be converted.

Emissions- GHG levels
methane
climate change

Opportunities - Innovations from current and future technology.

Begin your answer to Question One here:

Dairy has been the fastest growing primary production in New Zealand, with the total output of milk production increasing 6 times in the period from 1995 to 2010. The multi-billion dollar industry makes up a significant proportion of New Zealand's GDP (18%) and has continued to grow into the third decade of the 21st century. Dairy's rapid growth in New Zealand has placed strain on certain areas of production that are affected by the intensive nature that dairy farming has become in New Zealand. With the price of milk solids surpassing \$10/kg and scheduled to reach higher into 2023, the intense production of dairy is bound to continue. This poses certain threats but possible opportunities for dairy's sustainability in New Zealand.

Dairy has high requirements for feed intake in order to produce more milk per cow and increase the overall yield of a herd. Essentially more grass needs to be grown to increase production. Since the start of farmland dairy conversions in 1990, the use of synthetic nitrogen fertiliser has increased 625% on dairy farms, which is incredibly significant. With this increase of nitrogen it shows that the production of grass will be higher, but the system that farmers are applying it is wrong. Many dairy farmers will apply up to 400kg/ha of nitrogen throughout a year, but not understand the

requirements for grass growth. Once the uptake of nitrogen in pasture has reached a surplus level, ~~then~~ any excess is sitting and washed away by groundwater systems into freshwater streams and rivers. The 625% increase of nitrogen on dairy farms directly correlates to the fact that there has been an increase in nitrogen levels throughout freshwater systems in New Zealand. 40% of rivers in New Zealand are considered unsafe to swim in, due to the increase in nitrate and phosphate levels from synthetic fertilisers (urea, DAP, super phosphate). New Zealand District Health Boards decided a safe level of nitrate in water to be able to consume was 11.3mg of N per litre of water. ~~and~~ The level of nitrogen in the Waikato River increased from 3.9mg/L to exceeding 9mg/L from 2000-2018, now just sitting under the threshold considered to be safe to drink. Waikato is the second largest dairy region in New Zealand in terms of milk output, showing that dairy was the driving factor. From this we can see the huge environmental impact that dairy holds, and that if it is not addressed that freshwater systems in New Zealand will reach a point that they can no longer be consumed. This is far from sustainable, as being the nation with the second most available freshwater behind Canada in terms of litres available per person we have a responsibility to preserve freshwater at a clean healthy level so that in future years freshwater

rivers like the Waikato can still be used for drinking water for the entire region.

Another factor that impacts the sustainability of New Zealand agriculture is the significant emissions that are released into the atmosphere from dairy. New Zealand contributes around 0.5% of all greenhouse gas emissions, with the majority of this being from dairy. The sharp uptake of dairy conversions increased the amount of total cows, but innovations also meant that herd sizes increased too. As rotary milking sheds have become more popular, the herd sizes of dairy farms have ~~has~~ jumped up 45% as the milking process becomes more efficient allowing the size of herds to be larger. Increase in herd sizes have made dairy farming ~~as~~ far more intensive. More cows on the same amount of land make output higher per hectare but also means that the effect on soil quality, nutrient leaching and also GHG emissions more problematic. There is an obvious link between emissions and inevitable climate change. Dairy already requires significant irrigation, particularly in areas such as Canterbury. Only 3% of all agricultural land in NZ is irrigated, and of that 70% is in Canterbury. New Zealand is expected to be considered in drought for another three weeks of the year by 2050, influenced by emissions increasing temperatures and effecting climate change. Irrigation cannot

increase much more than the scale it is already at in Canterbury, meaning that ~~any~~ irrigation for longer dry periods when water isn't available means that the whole of dairy in NZ's largest and most productive dairy region suffers. This forces New Zealand to realize that if emissions continue at the rate they have from the last 10-20 years from dairy that the sector will be strained during the next 30 years from more drought.

Despite the fact that dairy poses many threats for it not to be sustainable, there are signs and continual innovations that can lead to opportunities for it to be sustainable. VRI Irrigation is an innovation that means that in pivot irrigators the ratio of water applied to pasture can be altered along the irrigator, and the rate of water applied during certain times of the day can change. This innovation should mean that ~~open~~ nitrogen leaching into waterways will drop, as after nitrogen application rates of water can be changed to wash nutrients into pasture but not exceed its requirements and wash nutrients into freshwater systems. 50% of urea used in New Zealand now has 65% extra coating on the outside of pellets, meaning they are acting as slow releasing fertilisers to mitigate the risk

Further

of losing all nitrogen into waterways. Irrigation grants and dairy farm conversions are at next to none, meaning that total effects ~~on~~ of dairying in the future should stay at ~~the~~ or around the levels we see today in terms of emissions.

Dairy farming will continue to be New Zealand's primary agriculture sector for many years. Despite having many threats to the sustainability of NZ agriculture, there are several opportunities to go along with this to prove that while being one of the most intensive dairy setups in the world that the environmental issues that are seen in other parts of the world do not happen here and the industry continues to be successful into the future.

QUESTION TWO: Labour issues in the primary production sector

Primary production system: Apples

PLANNING

Apples - Seasonal work Mid Feb to Late April

50% NZ

33% RSE scheme

17% Backpackers] severely affected by COVID

2021 - Over 20% of apples wasted not enough labour

Labour mistreatment - violations from employers

Places RSE scheme at risk

Hand thinning - not done - flow on effect

Begin your answer to Question Two here:

The horticulture industry in New Zealand has struggled with sourcing labour for many years, likely due to it being seasonal and long hours outdoors. The apples industry is an \$830 million export industry in NZ, being suited to grow ^{apples} due to long summer sunshine hours and suitable soils for growth.

During the 2021 season over 20% of apples grown in Hawke's Bay were estimated to be wasted from a lack of pickers. This has been affected by quantity and quality of labour during the past years, and the treatment of workers which could affect future productivity.

The breakdown of where labour is sourced from in order to pick apples in New Zealand has a large account in why recent years that sourcing labour has been so difficult. In 2019, 50% of work seasonal workers in orchards were from New Zealand, approximately a third were RSE workers sourced from many islands around the Pacific, and the remaining 17% were overseas travellers to New Zealand that were working in orchards while ~~on~~ during the summer but not recognised seasonal employees. Since the start of the COVID lockdown in 2020, the amount of overseas travellers entering NZ has reduced by 80%, and only in the last 6 months has people started to travel again. This means that there

were no backpackers in New Zealand for the past two seasons of apple harvesting, essentially removing immediately 17% of the workforce needed to harvest the apples in New Zealand. The 33% that were sourced from RSE workers were reduced as well, because the Government wouldn't grant access to the several thousand employees that would normally enter the country to complete the ten week harvest. In 2021/22 season it was estimated that nationwide there were 10000 workers short of what there needed to be in order to successfully harvest all orchards of apples. In all COVID reduced the total workforce by approximately 35%, and would have been more if companies hadn't pushed for the New Zealanders to fill the gap that were left from all backpackers and some RSE workers. Going into the 2022/23 season it is now a challenge for employers to keep RSE workers in New Zealand, as many were mid harvest during the COVID lockdown in 2020 and haven't returned home to their families yet, meaning that they are likely to stay home during this harvest. Travel has still not hit the level that it was at before COVID, as more people have settled down and more people are weary of the potential danger that comes with travelling if they are to be stuck overseas. This all contributes to the labour

issues that are being faced by the apple industry currently. Labour shortages currently also have flow on effects into the next year. Hand thinning is conducted in January, which is a process of thinning apples in order to allow bigger apples to be grown. This has not been conducted during the last few years due to the reduction of workers, meaning apples are of lower quality and mature later in the season when premium buyers price is gone. This places the next season to be later to begin harvesting, showing the negative effect that labour shortage has not only currently but into future years.

Future productivity of the primary production system of apples could be majorly affected if labour shortages continue. This could happen if RSE workers are not granted into the country on their current scheme. The apple industry has been noted for the mistreatment of RSE workers, which has meant the Government has said that if the treatment doesn't improve that they will no longer give the industry access to RSE workers. ~~Because around 1/3 of all apple harvesters nationwide are sourced from RSE workers, it would have a huge effect if they were no longer allowed to be in New Zealand from mid February to late April to~~

continue the apple harvest. Employers have been known to not provide RSE workers with basic humanitarian rights, such as up to standard accommodation to stay in, reasonable working conditions and hours and legal pay. The bond between employers and RSE workers needs to be strong, otherwise the industry could have more years like in 2020/21 in which they suffered a \$80 million loss from wasted fruit on trees. Employers will struggle to source the remaining 33% without RSE workers meaning that for the sake of their future productivity they need to not only give RSE workers the bare minimum but create strong links to ensure that workers will return year after year and benefit the apple harvest. The RSE workers themselves also rely on coming to NZ to work the summer and make a living to go home and provide for their families, meaning that it would be a significant issue if the apple industry lost RSE workers.

The apple industry has suffered from two of their worst seasons ever in the last two years, suffering \$80 and \$67 million in losses. This ~~has~~ The labour issues that is happening has had an obviously stark effect on the sector itself. However employers must think towards future productivity and that if they are going to succeed

heading into the future that they are going to need the aid of RSE workers. Losing 33% of the workforce forever will have almost irreplaceable damage on the sector, so employers must work hard to provide for RSE workers in order to preserve the future productivity of the apple industry in New Zealand.

QUESTION THREE: Producing for niche markets

Primary production system 1: Lamb Atkins Ranch (USA)

Primary production system 2: Rockit Apples (China)

PLANNING

Lean Meats 1989

41500 carcasses

22kg CWT

Big French Rack

2-3% meat sales
in US lamb

Rockit Apples

50-75mm in size

500ha in NZ

65T/ha 28 apples/tree

62% less waste than
normal production

sold in tubs

Easy appealing

Begin your answer to Question Three here:

New Zealand has always been good at producing commodity products into mainstream markets in the food and fibre sector. However niche markets can be opportunities to hit a smaller group target of customers to provide a higher return than commodity products. Lamb exported to the USA through Atkins Ranch and Rockit Apples exported to China and South East Asia are two examples of producing products for niche markets in New Zealand that have had great success and returns in a challenging system in New Zealand to produce for a niche market.

Atkins Ranch was established in 1989 under Lean Meats NZ to supply Whole Foods Market in the USA and Canada with lamb. Lamb produced for Atkins Ranch has a targeted CWT of 22kg, compared to an average lamb CWT of 18kg that is exported to China in bulk. The 22kg carcasses are targeted to reach a bigger eye muscle, and therefore a larger fatter French Rack and loin. This is suited for the USA market in particular who are more inclined to a fatter product than the leaner lamb that is exported to China. 2-3% of all meat sales in the USA is lamb, showing that it is a relatively specialised product compared to the significant ~~meat~~ beef sales and consumption of beef.

415000 carcasses are exported through Atkins Ranch to the USA yearly. The remaining carcasses that do not reach the USA are processed through Oration in New Zealand. Most meat when exported is frozen, but all carcasses sent to the USA through Atkins Ranch are chilled. This means that after the five week journey to the USA from NZ that carcasses do not have to be defrosted before handling and are of considerable benefit to the fattier tasting lamb. Lamb pelts are also sent to the USA through Atkins Ranch, making around \$14 to supply US Ugg boots. If kept in NZ pelts hold a \$2 dumping fee. This shows the differentiation in product from Lamb exported ^{through} Atkins Ranch to the USA and the leaner lamb exported to China.

Rockit Apples were created in Havelock North and were a hybrid apple designed to be far smaller than any other mature apple, measuring only 50-75 mm in diameter. The apples are branded as a small healthy snack, being the size of about $\frac{1}{3}$ of a normal sized Envy apple. There is currently only 500ha of Rockit apple plantations in New Zealand, making up about 5% of all apple plantations. 100 million apples were exported from Hawkes Bay Rockit in 2021 and is expected to rise to \$400 million in 2025. The demand for the apples have been crazy

in Asia, with China increasing the amount bought by 40% between 2020 and 2021. The primary difference is not just the small size of the apple, but also how they are sold. Apples are sold in plastic tubes of between 3 and 6, which provides a significant point of difference not just for purchasing but for handling too. Once washed after harvest apples are placed in a tube and not handled until the purchaser opens the tube. It is easy and convenient as the tube is resealable and several can be bought at a time. Having ~~them~~ apples sold in a tube really diversifies the product, as apples in a tube have the potential to be sold in airports, subways, hotels all while staying fresh. They can also be sold in vending machines, another point of difference. Rockit apples have a brix level of over 16, meaning they are high in natural sugar levels, but also have a taste that is not too sweet or tart. ~~The~~ The apples themselves are 30% more red than a normal Braeburn apple, to target the Chinese market as red is associated as a lucky colour. Rockit apples have achieved to having a very different product and marketing to anything that is on the market currently, which have made them very successful in exporting to Asia in the past few years.

Producing for a niche market in New Zealand have many challenges but also many opportunities. One of the biggest challenges is the fact that it goes against the grain of usual food production in New Zealand. The output of commodity products has been how New Zealand has traded for a long time, which makes it hard to kickstart a niche product and have the support and means to get it to the niche market. Another significant challenge is being able to differentiate enough and not have other companies copy you. Rockit apples are unique enough in the fact that they are the only apple that can have the taste it holds for an apple of that size. This means that there is no competition for them, which is important in niche markets as if the supply is flooded for limited demand, it can kill niche markets. China have attempted to brand selling Envy apples in a tube, but has not had the same success due to Envy apples being three times the size and not as aesthetically pleasing on the eye. Atkins Ranch are the main supplier of the U.S for lamb, and buyers in China don't want fatty lambs that are grown to the size of 22kg CWT, meaning that they have the main stream supply of the U.S.

Opportunities can also arise from the innovations of supplying a niche market. Despite plastic being a thing that is negative for the environment and going out of fashion, Rockit Apples have made their tubes 100% recyclable and have innovated to make cardboard packaging that is 100% biodegradable. There is 62% less waste in the production of Rockit Apples from the tree to the consumer, than normal apple production showing that they are leading the way for the apple industry. Rockit apples yield around 65T/ha, or 28 apples per tree, meaning that for their small size that they are still competing with mainstream apples in yield. Rockit aims to be carbon neutral by 2023, showing that despite supplying a niche market, that they can be ahead of commodity products. By Atkins Ranch chilling carcasses instead of freezing them it delivers a fresher product to the customer in the USA than what is received by the commodity lamb in China. Niche markets often have more particular and fussy customers, which is an opportunity for niche producers as they have more need and incentive to meet the needs of customers. This produces a better feedback loop for the producers and better results for customers.

Producing for niche markets in New Zealand is not easy, as it goes against the grain of NZ producers and must have a product that is

QUESTION
NUMBER

Extra space if required.
Write the question number(s) if applicable.

3 specialised and not easy to replicate. Customers are also more likely to be fussy. However, the opportunity to lead the way in terms of the environmental and social factors that are not addressed by commodity products are great opportunities for niche market producers. This along with higher returns for the specialised products provides N2 producers supplying niche markets with great incentive to continue and make good profits.

QUESTION
NUMBER

Extra space if required.
Write the question number(s) if applicable.

Outstanding Scholarship Exemplar 2022

Subject	Agricultural and Horticultural Science		Standard	91305	Total score	20
Q	Grade score	Annotation				
1	6	The answer focusses on the intensification of dairying and its future sustainability considerations. These have been well discussed and there is discussion of the threats and opportunities that the environmental issues pose to the future sustainability of dairying. While the candidate has honed-in on the fact that environmental issues are the key ones for future sustainability of the industry, what is lacking in this response (and what prevented it going beyond a scholarship grade) is discussion of a broader range of factors and a lack of real perception / insight within the answer.				
2	6	Here the candidate has presented an articulate response on the labour issues faced by the apple industry, and the productivity impacts of these issues. A detailed discussion on things like the impacts of COVID and the RSE scheme, and the seasonal nature of the labour requirements, have been linked to productivity within a well-structured, scholarship answer.				
3	8	In this answer on lamb and apple producers targeting niche markets, the candidate has presented a perceptive, articulate, and insightful response to the question. Having first introduced how / where the two products are differentiated, the challenges and opportunities of niche marketing are perceptively discussed. The differentiation and marketing of Rockit apples and the risks of 'flooding' markets are covered, as are innovations with the packaging.				