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Scholarship 2020 Agricultural and Horticultural Science

2.00 p.m. Monday 16 November 2020

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.

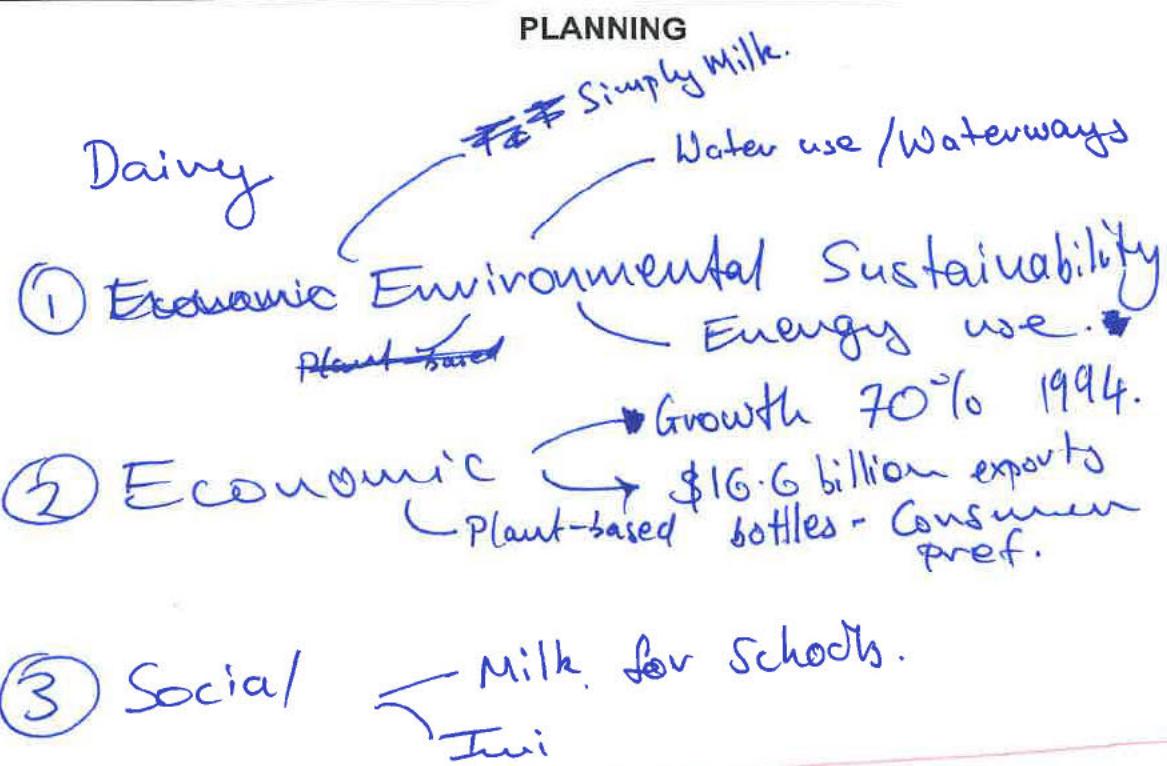
Write your answers in this booklet.

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: The future sustainability of primary production



Begin your answer to Question One here:

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Dairy is not only a cornerstone of New Zealand's economic ~~but~~ economy, contributing ~~of~~ \$16.6 billion in export earnings, but is intimately woven into the fabric of New Zealand society. Thus, the future sustainability of dairy in New Zealand is of the utmost importance and must be led by a ~~the~~ cooperation between business and the government. Whilst there are still significant sustainability challenges for New Zealand dairy, ~~but~~ the industry is overall taking positive actions in 2020 to ensure that it can remain relevant and ^{profitable} ~~important~~ for future generations.

~~The~~ Dairy has ~~not~~ Environmental objectives and policies are allowing the dairy industry to become ~~more sustainable~~ enhance its future sustainability. Traditionally, NZ dairy has been an environmental burden on NZ society given the way in which it ~~uses~~ contributes

to the production of ~~greenhouse~~ greenhouse gases, such as methane, and carbon pollutes New Zealand waterways through fertiliser run-off and cow effluent.

However, Fonterra is attempting to address these significant environmental concerns through ~~process~~ changes to the production process. ~~99.6%~~ 99.6% of waterways, ^{on dairy farms} for example, have now been fenced, and limiting the ability for cows ~~effluent~~ and cow effluent and urine to be ~~directly~~ directly deposited into rivers and streams. Similarly, extensive riparian planting across New Zealand is ~~reducing~~ will reduce the stop some run-off & from reaching waterways whilst simultaneously reducing sedimentation. Moreover, Fonterra is attempting to reduce the industries carbon footprint as seen in its release of Simply Milk, which is carbonzero milk, in 2020. The ~~emissions~~ ^{carbon footprint} created in the production process

for this milk, which is 2.0 kg CO₂ per 2 L bottle, is offset by Fonterra's work with Toitū Envirocare, including the regeneration of native forests and Gold Standard projects such as ~~is~~ investing in renewable energy. Clearly, the business model used for Simply Milk provides a platform from which ^{Dairy in NZ} Fonterra can look to become more environmentally sustainable in the future.

Furthermore, ~~the~~ dairy's economic performance and growth highlights contributes to its future sustainability. Since 1994, ~~the~~ dairy industry ^{in NZ} has grown 70% with ~~there being~~ there being approximately ~~to~~ 6.5 million dairy cows in the country in 2018. Whilst economic growth in terms of hectares of land used for dairy may be limited by the scarcity of land ~~able~~ & able to be used for dairy farming, economic growth & can still occur in the future through

increasing efficiency, responding to consumer tastes and preferences, and growing our export market portfolio. For example, the introduction of plant-based Anchor bottles ~~in the North Island~~ is a clear example of Fonterra responding to a growing preference, especially among young consumers, for environmentally sustainable products. This sugarcane-based bottle HDPE bottle could be introduced across Anchor's entire range in the future ~~is~~ depending on the ~~the~~ ability of the supply-chain to respond to a larger greater demand for these bottles. Similarly, whilst NZ dairy does have some level of dependency on China with NZ\$200 million of dairy exports & revenue being collected from China in the year to June 2020, diversification could ensure the future sustainability of this industry even if there are changes to ~~to~~ China's demand for milk solids or restrictions ~~to~~ on NZ's access to China in the future.

For example, current negotiations for an NZ-EU Free Trade Agreement could allow NZ dairy greater access to a lucrative market that they have been largely shut out of ~~poorly~~ due to the Common Agricultural Policy and extensive tariffs on foreign dairy in the EU. Evidently, responding to changes in ^{both} consumer preferences and trade arrangements will be critical in ~~now~~, guaranteeing the future sustainability of NZ dairy.

As well as this, social considerations being socially responsible and aware is ~~is~~ an important part of the future sustainability of the industry.

Consumer expectations are changing for ~~corporate~~ industries and firms are changing meaning that in that consumers now ~~demanded that~~ ~~that~~ want all industries to make positive social contributions.

The co-operative business model of Fonterra to some extent ensures that social considerations are an integral part of ~~the~~ the New Zealand dairy industry as farmers on the ground have a ~~relatively~~ significant role in ~~the~~ decision-making. The Milk for Schools programme, for example, has ~~allowed~~

*See pg 23

QUESTION TWO: Global trade disruptions / changes

PLANNING

Dairy

- ① ~~Trade Agreements, CER.~~
 CPTPP
 Malaysia
 Japan
 ② Limited

Kiwifruit

Japan. ✓ \$26 million put on

Zespri's involvement
 in Iran
 25% - China

- ② Political Disagreements
 eg Aus.
 Vulnerable to China's reaction
 Impact on Diplomacy:

- ③ Benefiting from political disagreements of other nations.

Brexit.
 EU / Br trade.

Trade ties with Europe.

- ④

Begin your answer to Question Two here:

As a ~~geographic~~ nation with ~~such~~ a relatively small domestic market of 5 million people, and growing primary production industries, global trade and New Zealand's export markets are perhaps more important than ever before for New Zealand. Political agreements and disagreements both have the capacity between countries to have the capacity to both enhance and jeopardise the exports of NZ dairy and kiwifruit. ~~with kiwifruit imports, the~~ New Zealand government can take diplomatic actions to ~~ensure~~ that give these two primary production industries greater stability and ~~safety~~ ensure that political agreements are profitable for ~~these~~ farmers and orchadists in NZ. //

Political agreements can have created new trade opportunities for New Zealand's exports to both the dairy and kiwifruit. Closer Economic Relations (CER) (1983) has created important trade ties between NZ and Australia ~~more~~

the EEA with it leading to the removal of almost all tariffs on goods traded between the countries.

Dairy, for example, significantly benefits from this access to the Australian market, exporting NZ \$1700 million of dairy products across the Tasman in the year ended June 2020.

The importance of CER^{and free trade} in creating & providing fertile ground for the large export revenue is highlighted by the way in which NZ collected only NZ \$950 million of

dairy export revenue from the US

in the year ended June 2020, despite a US population of 330 million, due to a quota-tariff

~~tariff quota system~~ on dairy that the US has in place. NZ butter for example

has to compete for import licenses for example, to ~~export to the US~~ to export the

tariff on NZ butter into the US is

1% within the quota but this increases

to 12.7% outside of the quota

making exporting butter unprofitable beyond the 10.2% of the ~~global~~ total

US butter quota ~~that~~ that NZ has import

licences for. Similarly, the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP) has had positive repercussions for NZ kiwifruit with Japan agreeing to remove its \$26 million worth of import duties on the fruit. This will aid Zespri in its attempts to further establish NZ kiwifruit as a prominent, luxury fruit within Asia.

However, ~~New Zealand~~ political disagreements prevent substantial threats to the profitability of NZ dairy and kiwifruit. Whilst NZ is heavily reliant on China for trade, with 25% or \$21\$ NZ\$500 million of NZ ~~\$117~~ NZ\$450 million or 25% of NZ kiwifruit ~~sales~~ exports going to the Chinese market in 2018, our political and diplomatic stances ~~do not~~ are generally more 'Western-orientated' and, thus, often clash with those of China. This presents significantly challenges for dairy and kiwifruit trade as being too critical of China could lead to ~~the~~ the imposition of tariffs or even

an embargo on trade in the most extreme cases. This issue is highlighted by the Chinese response to Australia's public proposal for an independent investigation into the origins of Covid-19, which involved an 80.5% ban on Australian turkey and ~~the establish~~ an inquiry into the dumping of Australian wine being established. Whilst some political disagreements with China may be inevitable, the NZ government can avoid significant consequences for the kiwifruit and dairy industry by ~~not~~ being ~~slightly~~ ~~more~~ avoiding being overly critical of Chinese policies. Nevertheless, it is important to note that such an approach ~~may~~ may be met with public resistance as many see actions such as ~~not~~ NZ ~~not~~ being part of not signing the Five Eyes' Statement on events in Hong Kong as morally regrettable.

Nevertheless, when political disagreements

that are ~~as~~ NZ is not involved in occur, NZ dairy and kiwifruit may benefit from changes in the trade of other countries. Britain's decision to leave the EU ~~will~~ has the capacity to increase NZ dairy exports to Britain significantly as Britain will no longer be part of the Common Agricultural Policy and can sign an independent free trade agreement with New Zealand. Importantly, NZ is well-placed to gain greater market access to the Britain given than ~~NZ~~ ~~was~~ dairy that, prior to Britain joining the EEC in 1973, NZ was ~~as~~ Britain ~~imported~~ more butter dairy from NZ than ~~from~~ any other country. Moreover, the US-China trade war and the cooling of Australia-China relations could see demand for both NZ dairy and kiwifruit increasing as China looks for alternative trade partners to strengthen ties with.

The success of Zespri Gold in China could be further enhanced by stronger trade links with ~~this economic superpower~~.
 *See Additional page.

QUESTION THREE: The position of genetic modification in New Zealand's primary production sector

PLANNING

- ① What GM is - HME ryegrass
 - ↳ Maizeflour
 - ↳ Sesame
 - VS Selective Breeding
 - Threat - deer
- ② Economic Opportunities.
 - ↳ Kiwifruit/Dairy
- ③ Environmental Benefits
 - ↳ Methane
- ④ Environmental challenges
 - ↳ Contamination
 - ↳ Superbugs
- ⑤ Cultural challenges
 - ↳ Mana
 - ↳ Whakapapa
 - ↳ Kaitiakitanga.

Begin your answer to Question Three here:

Genetic modification has the capacity to revolutionise the way in which New Zealand's primary production sector operates. The adoption of this ~~techno~~ technology could not only increase the profitability of industries, such as dairy and hortifruit, but could allow NZ ~~to~~ to take wholesale steps towards reducing our carbon footprint of ~~other~~ primary sectors. However, it would be naive to ignore the significant economic, environmental, and cultural challenges that this emerging technology presents. Thus, this essay will argue for ~~the~~ a measured and gradual introduction of GM to NZ's primary sector, which crucially needs to involve a partnership between ~~farmers~~^{industry} and central government to allow for appropriate legislation to minimise the risks of GM.

Genetic modification involves transferring genetic changing the composition of genes of animals, plants, & animals,

plants, or bacteria through the use of technology as opposed to natural processes. This often entails deleting, transferring, and adding, inserting genetic material from different organisms or species to the genes of the organism in question. For example, ~~the~~ genetically modified High Metabolisable (HME) ryegrass, which is currently being developed by AgResearch, is produced by transferring genetic material from ~~seas~~ sesame genes and nasturtium flower genes to the genes of ryegrass. Importantly, ~~the~~ GM is distinctly different from selective breeding as it involves a non-natural process, can be completed significantly faster, and allows for the transfer of ~~genes~~ ^{genetic} material between different species. The transfer of ^{change} genetic changes to genetic material generally have the purpose of changing the traits or growth of the organism, with HME ryegrass having a higher lipid content than regular non-GM ryegrass,

for example. //

The use of GM in New Zealand's primary production sector could provide significant economic opportunities to NZ's primary production sector. Firstly, Genetic modification can allow ~~to~~ make organisms ~~be~~ better suited to New Zealand conditions and, hence, more easier to grow throughout the country. KME ryegrass*, which could be utilised by the Dairying industry in New Zealand, grows 50% faster than regular ryegrass and is more resistant to drought due to a $\approx 9\%$ increase in water use efficiency.

Former principal scientist at AgResearch, Dr Greg Bryan, suggested that such improvements ~~in~~ in the growth and survival of this ryegrass could translate into increasing farms' revenues by "as much as \$900 per hectare."

Similarly, New Zealand kiwifruit could be genetically modified to be more resistant to ~~the~~ frost

and cooler conditions. Currently, this would allow for ~~the~~ kiwifruit to be ~~more~~ ^{better more easily grown} grown in areas such as Central Otago and the King Country and, thus, could increase New Zealand's overall production of kiwifruit, leading to higher export revenues. Nevertheless, Nevertheless, it is important to recognise Nevertheless the economic threat posed by losing NZ's clean, green image where industries such as dairy, beef, and kiwifruit are no longer "GM free." For consumers to export markets such as the European Union, which is strongly opposed to genetic modification, such a change would mean NZ beef would see a significant reduction in demand as it can no longer be labelled as "fed without GMOs" in French supermarkets. The sensitivity of consumers to GM was highlighted by the way in which Zespri initially had to put significant marketing resources into communicating that its Zespri Gold variety was non-GMO.

Clearly, whilst there are substantial economic advantages, a transition to GMOs could initially be met with resistance by consumers concerned about human health threats such as allergenicity and antibiotic resistance which some GM foods can pose.

Moreover, GM provides significant environmental opportunities to NZ's primary industries. As consumers and governments become more aware of emissions and water pollution, GM ~~inputs~~ inputs into the production process could provide a path for NZ's carbon neutral objective to be achieved. Methane is a key greenhouse gas that contributes to global warming and that is ~~produced~~ is a by-product of dairy and ~~sheep and~~ beef farming. However, HME ryegrass reduces the ~~emissions~~ methane emissions of cows by 23% as due to its higher lipid content with ~~the~~ plant oils being toxic to ~~the~~ bacteria that produce ~~methane~~ contribute to the production of methane. Furthermore, genetically modified kiwifruit that are pest resistant and disease resistant could reduce the need for the use of pesticides.

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

3 on orchards. This not only has the capacity to reduce the kiwifruit industries environmental footprint, given ~~the~~ pesticides often harm non-target species and reduce biodiversity, but could actually appeal to changing consumer tastes and preferences with more consumers demanding pesticide-free produce.)

However, ~~it is~~ it is very crucial to recognise the significant environmental challenges that GM the use of GM in agriculture and horticulture could present. Whilst pesticide-resistant fruit and crops may initially be successful, there is capacity for pests to develop resistance to these plants that are meant to target them, meaning that these pests effectively become 'superbugs' and may further damage primary industries. This occurred in Canada where the European Corn Borer has developed resistance to GM

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corn that was designed to reduce target this pest. Moreover, there is a significant risk of contamination with GM when GM crops and animals are used ~~in industry~~ ~~on farms~~. This is the process of ~~GMO~~ genetical material from GM species being transferred to non-target plants or animals, meaning that producers can no longer confirm what ~~crops~~ crops ~~can~~ be organic do not contain GM material, for example. Whilst this is a significant risk for HME ryegrass, government legislation providing for a 150m buffer zone between GM and non-GM grasses and for the use of male sterile ^{HME} ryegrass only could combat this issue.

Additionally, the use of GM technology provides significant cultural and social challenges. For many Maori, GM oppose GM for primary industries as it involves the unnatural mixing of the ~~Maori~~ ~~as~~ Maori or life-force

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Write the question number(s) if applicable.

of ~~organisms~~^{species} from different whāhapapa. This breach of the principle of kaitiakitanga or guardianship is seen^{by some Maori} as ~~dangerous~~^{reckless} and as an affront to cultural values. As part of a Treaty of Waitangi obligations, it is critical that the New Zealand government and NZ primary industries work with iwi and consider these legitimate objections to GM technology before relaxing any of NZ's currently relatively stringent laws surrounding GM in food production.

Overall, GM technology is a potential avenue for NZ primary industries to continue to explore and potentially gradually transition to in the future. However, to be ignorant of the significant environmental and cultural challenges of GM would be

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Write the question number(s) if applicable.

a disservice to the current and future generations of New Zealanders. Thus, any next steps regarding the introduction of technologies GM technology such as HME ryegrass should be taken ~~cautiously but optimistically~~ with both optimism and a degree of well-considered caution. //

- 1 → NZ dairy to make a tangible improvement to the lives of kiwi schoolchildren through the provision of milk for lunches. Importantly, this demonstration of corporate social responsibility changes the image of NZ dairy in the eyes of the consumer and, thus, has the capacity to lead to ~~positive~~ positive economic implications. Consultation with iwi is another fundamental key to ensuring aspect of Fonterra's social responsibility particularly in regard to improving the quality of waterways which are considered ~~taonga~~ taonga. Clearly, this NZ dairy is adopting the dairy industry in NZ

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is making necessary changes to becoming more socially sustainable and communication with all stakeholders in the production process to can ensure that social considerations continue to be a prominent aspect of the industry //

In ~~con~~ summation, the NZ dairy industry is in a sound position to be able to ensure its future sustainability through acknowledging and addressing economic, social and environmental factors.

However, it is crucial that this position does not breed complacency and the industry led by Fonterra continues to set objectives such as reducing water use in ~~high~~ water-constrained areas by 30% by 2030 and reducing energy intensity at manufacturing sites by 20% by 2020 (a target which they have recently achieved). //

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Overall, New Zealand is in an excellent position to take advantage of these global events but must ensure that industries such as dairy and kiwifruit do not become overly reliant on a single export market such as China. Diversification through agreements such as the CPTPP is key to avoid avoiding large falls in export revenues as NZ dairy experienced in 2015, partly due to being overly reliant on China.

~~Continuing to run an independent economy~~

PTO