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Scholarship 2021 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.

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.

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Question One

New technologies are a big part of the future of farming, especially in the industry we are already seeing how technology can be used in the production system to increase efficiency, and reduce costs, and there are many advantages that new technology can have for the apple industry. Automation is the best way for apple producers to be more efficient and reduce their costs leading to more production and higher profits, meaning there are many advantages to new technologies, but there are also some disadvantages. Some of the biggest technological advancements impacting the apple industry is automation within the packhouse, produce barcoding, and automatic apple pickers, both of which have some disadvantages and many advantages.

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Technology is the way of the future, and automated fruit grading technology is now refined and effective. These machines can grade apples based on colour, size, and blemishes and discard any apples that don't meet market requirements fully automatically. This automation within the packhouse is much more efficient and accurate than manual grading, and producers don't have to pay for workers to grade their apples. This technology is very advantageous for apple producers as it works much faster and significantly reduces their costs of wages, as they only have to pay staff to oversee the machines rather than doing the work in the packhouse. The only real disadvantage of the automated grading machines is that they take away jobs from the local region, which means they are bad for employment rates in the country, however this sacrifice is worth it as it increases the country's efficiency, total output and profits which leads to more spending in local regions, countering the impacts of less employment in the apple industry. Apple producers can buy these machines and have a nearly fully automated packhouse, and the technology can only improve from here, whether it be reducing the capital costs of machines, increasing efficiency or automating more sections of apple production. //

Produce barcoding is a new technology that we will likely see apple producers begin to implement over the next few years. These barcodes would go on their produce in supermarkets so that customers can choose to scan them and see how the apples were produced, and the impact it is having on the environment. This may mean that apple producers who are more environmentally friendly and sustainable may begin to receive higher prices for their products than those producing unsustainably, as many customers would be willing to pay for a more sustainable product. Produce barcoding is technology that will likely develop in the near future to make it easy for producers to put it on their products, and easy for consumers to quickly review a product's environmental impact and sustainability in a way that is convenient and fast. This technology only really has benefits if you are a good producer and focus on improving your environmental performance. This technology will have an overall positive impact as most farms will become more sustainable and more environmentally aware, which is good from a global viewpoint, as well as a regional view as the place we live will be more sustainable, and we will be less harmful to the environment around us. Another advantage is that produce barcoding will likely generate more revenue for producers who are currently environmentally friendly or less harmful, and will make it more difficult for producers having heavy negative environmental impacts. Without produce barcoding technology all apple produces will be lumped together and their apples will not be separated as being better or worse for the environment, which is why produce barcoding is good technology with many advantages and we will see it implemented into apple production and marketing in the very near future. //

Another technology that is nearly ready to be adopted and used on a large scale is automatic apple pickers. These machines have been in the works for many years and are now being trialled on farms. We would expect in the next few years apple producers will begin to adopt these into their production systems. These automatic pickers drive down rows of apple trees and pick the apples fully automatically. There are many advantages to these autopickers, and although they will require initial investment they will significantly reduce costs of production. The first major advantage is that it removes the major cost of apple pickers, and also is a solution to labour shortages. These automatic pickers also detect blemishes, and pick fruit that is the right colour and count size, meaning there is no need for a packhouse as its job is done while picking. This further reduces costs of production as they no longer need to pay for transport to and from the packhouse, packhouse employees or running costs of the packhouse. Auto pickers also work day and night, 24/7 unlike employees, and have no sick days, meaning they can pick the apples much faster and therefore get to market earlier, providing better return for their apples. The only disadvantage of automatic apple pickers is that they currently require a 2D plane to pick, meaning orchards need trees that are very thin and have no depth, and they also need wider rows for the auto pickers to drive down. This means that auto picking orchards are less efficient in their land use, as the trees can carry less apples, and there are less trees per hectare. However, this one disadvantage is outweighed by all the advantages of autopickers, which cause increased efficiency, and heavily reduce costs of production for apple producers. This new robotic picking technology is likely to be the future of apple production, as it has so many benefits of using them, which is why the technology will likely be adopted into apple production systems over the next few years. //

While technology can have disadvantages, including taking jobs from workers, it can also increase primary production systems efficiency, reduce their cost of production and is beneficial to both producers, consumers and the environment.

These three new technologies of automatic apple grading, produce barcoding and in particular robotic apple pickers are the most important technologies in the apple industry, that will change the way we produce, and will increase outputs and efficiency, while also increasing profits for apple producers. Some people are cautious about technology, particularly automation but it is the way of the future and we will see it being implemented in apple production in the very near future.

Question Two

A resilient primary production system is able to adapt to changes whether they be economic, social, political, or environmental and continue their production even when disrupted by events. A farm's resilience is tested by labour, innovation, climate change, social environment, weather, geopolitical factors, politics, the economy and more. In 1987 when the New Zealand government removed the farming subsidy in the country, 90% of farmers said they would sell their farm, however after the subsidy was removed only 10% did. Even though almost every farmer was reliant on the subsidy previously, when it was removed 90% of them adapted to the change and continued production, showing their resilience to this disruptive event. The resilience of dairy production systems are currently being tested by a range of disruptive events, the major ones being Covid 19, rules and regulations, and competitors

The dairy industry has been resilient to Covid 19 over the past few years, and will need to continue to be resilient to maintain production and output. Partially due to Covid, shipping has become a lot more difficult and a lot more expensive, with shipping costs increasing 10 fold over the past year, and due to countries going in and out of lockdown and a constantly changing world due to Covid, it is more difficult for producers ship their milk overseas. This has required resilience from dairy farmers as they have to find ways to fund the increasing shipping costs, but also get their milk to the right markets overseas in a changing world where countries are opening and closing borders, and some not allowing our exports into the country. The dairy industry has had to be very resilient in the past few years in relation to Covid 19, with rising shipping costs and the difficulties coming with exporting their milk. 66% of our milk exports go to China, and with China having multiple lockdowns it has made it difficult for us to ship the usual amount of milk there, so producers have had to be resilient and find other countries to ship our exports, and has shown that we cannot rely too much on one country to sell our product to. The producers have adapted their production systems and got around the issues, continuing production through these disruptive events which shows our dairy farmers can be resilient.

The dairy industry has had to be resilient to rules and regulations coming into place, for example the requirement by government for all dairy farms to fence off significant waterways, and the recent push to reduce nitrogen leaching from farms and methane gas emissions. The regulations that were put in place by government for farmers to fence off waterways was not met kindly, as many farmers complained about the huge cost of the fencing, but it was a change that had to be made in order to reduce dairy farming's impact on waterways. Dairy farmers had to be resilient, by finding a way to pay the cost and fencing off their waterways, and this is just one regulation that has been put in place, there are likely to be many more regulations put in in the future. Currently there is a big focus on environmental sustainability, and so therefore there will inevitably be more changes dairy farmers have to make to become more environmentally friendly, and reduce their impact on the environment. Rules and regulations are a disruptive event that impacts dairy farmers heavily, especially with recent global focus on sustainability, and it is an event that is likely to occur again very soon. Dairy farmers have to show their resilience by finding a way to fund the extra costs of rules and regulations, and adapt their production systems to meet any goals or standards that are likely to be set on methane gas emissions or nitrogen leaching. Rules and regulations are an event that will always be occurring, and changing and resilient farmers will deal with the change, and thrive under the new conditions.

(VP) The dairy industry also has to be resilient to competitors, with the rise of milk substitutes such as almond, soy, oat, rice milks and more, as people turn to alternative milks that are more sustainable, and more environmentally friendly. Dairy milk is significantly more water intensive, uses more land area and has the worst environmental impact through emissions and impact on waterways than any of the alternative milks. In order to adapt to these changes the dairy industry has to focus on being more environmentally friendly and more sustainable so that their product can compete with or be better than the milk alternatives, because currently the only real factor it has on its side is being cheaper. Dairy milk's competition is reducing dairy sales and will likely continue to reduce dairy sales unless the industry makes a change to become more sustainable. Farmers need to work on reducing their emissions, impact on waterways, overusage of water and other environmental factors in order to be resilient against the competition. A farmer that says I don't need to sell my milk to those that want alternatives, or simply says that environmental sustainability is not necessary is not a resilient farmer and will likely end up selling the farmer a few years down the line when sustainability becomes a requirement, and they can't sell their milk to Fonterra because their environmental impact is not up to standard. This is why a resilient farmer will start making changes now so they are ready for when the market requires sustainability, and so that they can compete with the competition of milk substitutes.

Recently we have had many events that have disrupted production, with Covid, the current push for global sustainability and environmental friendliness causing new rules and regulations to be put in place, and the rise of milk substitutes markets that are reducing dairy milk sales. Because of all these events the dairy industry and all dairy producers have shown resilience on

their farm, by adapting their production systems, meet government and council requirements, and finding ways around the issues that threaten their farm. Many dairy farms have also shown they want to focus on improving environmental performance to get ahead of future regulations and be prepared for future disruptive events, which shows a lot of resilience, as they are prepared to adapt their production systems to meet market requirements and continue production. Dairy farmers are likely to have some tough years ahead with the focus on sustainability but they have shown they are resilient and most will be able to adapt and thrive even with disruptive events impacting them.

Question Three

New Zealand's freshwater management can be split into three main sections, our water quality, water allocation, and infrastructural systems. It is difficult to balance economic and social factors with our environmental impact, and focus on long term issues as well as having a short term focus, but our freshwater management systems are not right, and need to be more balanced, more efficient and better for everyone. As a country we produce enough food for 40 million people, so while our population is only 5 million it is understandable that our water systems are struggling, and our water quality is degrading. The biggest primary production system impacting our waterways in New Zealand is dairy farming, which has high water usage, and is a big cause of the water quality issues our country is facing. The other primary production system I will focus on is apples, which are reliant on water to keep their trees alive and healthy.

Water quality is a severe issue that we do not seem to be improving. One of the main issues is the high levels of nitrates we have in our freshwater, meaning many of our waterways are not safe to drink from, or even swim in. Dairy farming is the main contributor to nitrate-nitrogen levels in water, as the combination of irrigation, nitrogen fertiliser and the nitrogen in cows urine is too much for soil to hold, so the nitrates leach through the soil into waterways, and fencing of waterways cannot stop the nitrates. One of New Zealand's biggest dairy farming areas, Canterbury conducted a study of 322 boars in the region, of which 20 had nitrogen levels over the safe drinking limit of 11.3mg N/L. 36 of the boars had E Coli levels that were considered dangerous, and many more boars would be close to the safe drinking limit for nitrogen, which new studies show levels of nitrogen above 0.87mg N/L may increase risk of bowel cancer. Of the 20 boars over the limit, 13 were in Ashburton, an area that has come up on dairy farming recently, and thrives because of it. Ashburton is sacrificing environmental performance, but is doing very well economically, and socially. The region is thriving so much because of the dairy farming, that there were only two people unemployed in the region that the mayor knew by name. This shows that we need to focus more on balance social and economic with the environment, as the region is thriving socially and economically, but having negative environmental impacts that are causing the water to be unsafe to drink. The country needs to focus on improving our water quality to make it safer to drink, and swim in our waterways, rather than focusing so heavily on GDP and employment rates.

Our freshwater management also has serious issues with allocation of water, because many farms have old consents that allow them to use ridiculous amounts of irrigation, and some newer farms cannot get consent to use any, meaning there is a clear imbalance and an issue with the system. Because some farms have consent to use high amounts of water they are not worried about being efficient with water which is a scarce resource they just throw lots of water on because they can and its a free resource for them, and it generates more profits through more irrigation. Some apple orchards may not have any water consents, or very low limits which mean they cannot water their trees and many trees may die due to lack of irrigation, whereas some of these dairy farms are using absurd amounts of irrigation because it produces more food for their cows, which produces more milk. With new smaller apple trees they have shallower roots and therefore are more reliant on getting water to stay alive, so apple orchards rely on getting allocated the water they need. Clearly, the current water allocation system is not fair or balanced, with older consents having very high values and new farms struggling to get any water at all. This leads to inefficiency and farms wasting a scarce resource as for some farms it is free, and provides benefit to them to throw on as much water as possible.

There is also a significant lack of water management infrastructure, particularly treatment plants and water storage. Currently our treatment stations cannot deal with the amount of sewage, and when there is heavy rain often have to just dump sewage into our waterways. There is also a shortage of water storage and collection systems, as 97% of rainfall ends up in the ocean, which many see as a wasted resource. The government and local councils are not spending enough on water infrastructure, for many reasons, some of the major ones being that they are focused too much on short term rather than looking at long term issues. If they don't start investing in treatment stations and storage systems such as the Ruataniwha Storage Scheme our current infrastructure will get more and more overused and will become useless. We need to invest in long term solutions by improving our water infrastructural systems, as well as any short term goals, because our freshwater management is currently not good enough and needs to be improved for more efficiency and better water quality.

New Zealand's current freshwater management systems need to be improved, in terms of water allocation and infrastructure so that we can focus on improving our water quality and making our waterways drinkable and safe to swim in. To do this we need to understand that we must balance our focus on economic, social and environmental factors equally, and we must look at long term solutions as well as short term problems. Water is an essential part of production for our primary production systems especially dairy and apples, which make up a large portion of our countries GDP and exports, so we need to fix the issues now before they get out of hand.