

No part of the candidate evidence in this exemplar material may be presented in an external assessment for the New Zealand Scholarship award.

# S

93105A



931051

SUPERVISOR'S USE ONLY

## SCHOLARSHIP EXEMPLAR



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

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

Tick this box if you  
have NOT written  
in this booklet

☐

### 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.

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

# QUESTION ONE: New technologies in primary production systems

## PLANNING

Production - technological irrigation, misting to control frost

Processing - automatic brix & dry matter measures at packhouses,  
 ↳ automated fruit grading - reduces costs of processing

Distribution → packhouses, storage - year-round supply

Marketing - <sup>link to technology</sup> IPP, Zespri branding helps to create strong brand presence to associate with quality.

- Barcoding allows for fruits to be traced back to growers, a form of protection against china

orchard gate return

\$ 75,000 green

\$ 156,000 gold - more economic

Begin your answer to Question One here:

ASSESSOR'S  
USE ONLY

New Zealand kiwifruit, specifically Zespri kiwifruit is a fast growing industry, with growth predicted to more than double by 2030. This fast growth has been accompanied by the investment and implementation of new technologies.

Zespri operates as a cooperative, meaning it's growers are also partial owners. This structure means that growers can voice their problems and concerns directly to managers at the top. These managers can therefore implement change to face these problems. This is in the best interest of Zespri as implementing change to face challenges quickly allows them to be market leaders. Additionally dealing with challenges quickly prevents costly outcomes, working to make Zespri more profitable.

Zespri kiwifruit growers have been using a range of technologies in the production stage of their system. An effective example of this form of technology in production is the use of automatic misting systems. Misting is a form of irrigation that is commonly used to prevent frost on kiwifruit orchards. Misting works to prevent frost by continually misting the vines with water. This then prevents the change in state from liquid to solid, and therefore the formation of frost. This is crucial as frost can be detrimental for fruit such as kiwifruit. The use of these automatic misters ensures that frost is prevented. Alternative forms of frost protection can be much more costly. The use of helicopters as a form of frost protection is common. The movement created by the helicopter can prevent frost, however it can be costly, priced at \$2000 an hr. The form of misting irrigation is much more

cost efficient, and can be just as effective. However the use of these technologies may be limited due to new water restrictions that are currently being turned into policy. These water restrictions would majorly limit the ability for growers to use irrigation such as misting. So despite how effective misting is, it may not be a viable solution to frost in the near future //

The production of kiwifruit has also implemented new technologies in the processing stage of production. Specifically they have implemented the use of automatic fruit grading systems. For Zespri this is particularly important. Zespri as a brand has built itself on its quality. So quality management is extremely important. Zespri has set minimum taste standards so fruit must meet these minimum thresholds in order to reach the overseas or domestic markets. Brix, and Dry matter are two significant measures of taste. Each kiwifruit variety (Sun gold, Zespri green) has different minimum taste standards. As these fruits pass through these automatic grading systems lasers are used to measure Brix and Dry matter. For gold kiwifruit 70% of those tested have to meet minimum taste standards, and for green kiwifruit, 90% have to meet their specific minimum taste standards. As the grading machines grade the produce they are separated by class. Fruit that meets the highest taste standard is considered class A, and can be exported. Fruit that meets the next standard is class B, and it for the domestic <sup>market</sup> consumption, and class C does not meet any minimum taste standards, and is used as animal feed or thrown away. This is important for these fruits to be graded



quickly, and correctly. The implementation of the grading technology has allowed for the productivity of packhouses to increase significantly. Increased productivity in packhouses, can result in decreased costs per unit, and therefore, decreased costs for Zespri. This is beneficial for growers, as the costs of essential services such as packhouses, and storage is taken out of their pay. Reducing these essential costs works to make growers and Zespri more profitable. Additionally the implementation of these systems has allowed for more accurate quality control. Zespri's brand is built on quality. So ensuring that quality standards are met helps to improve the reliability of Zespri's product, and therefore increase customer satisfaction, and potentially even brand reputation. There is a cost of these new technologies. The upfront cost of implementing these systems is significant. However the increase in productivity offsets these costs, meaning the impact on growers is minimal.

Zespri has implemented technologies in its storage and distribution stages of production. Specifically Zespri has invested in the technology that works to store and maintain kiwifruit quality. This technology is in the form of packhouse storage facilities. These facilities have zero oxygen, and are kept at  $0^{\circ}\text{C}$  or less. They have the addition of  $\text{CO}_2$ . This very particular environment helps to maintain kiwifruit quality. However it does mean that specialist gear must be used to enter such facility. The implementation of this technology has allowed Zespri to increase the amount of time kiwifruit <sup>can</sup> be stored. This is important for Zespri as it allows them to create a year-round supply of kiwifruit. Kiwifruit that is grown in New Zealand is packed & stored for up to 6 months, despite the harvesting period being only 2-3 months. (Counter seasonal) regions such as

Italy create a supply for the other 6 months that is not accounted for. This creates a year-round supply of fruit. This is a major goal of Zespri. They aim to generate a year-round supply of kiwifruit for all its markets in order to generate habits in ~~consumer~~ consumers. By also being available in supermarkets Zespri hopes that the purchasing of their product becomes a mindless habit. This goal is related to ~~st~~ their strict quality standards. It is important that their products meet these minimum test standards as they significantly increase the likelihood that consumers will repurchase their produce  $\therefore$  creating a habit. The implementation of this technology has allowed Zespri to change the attitude of consumers towards a somewhat exotic fruit, to a fruit that is regularly consumed. This has allowed for the kiwifruit industry to experience considerable growth. As of 2020 the NZ kiwifruit industry was worth 2.5 billion NZD in ~~GDP~~ <sup>Exports</sup>. Making them one of the largest Horticultural exporters in NZ, this growth is only predicted to increase as these consumer habits continue to grow.

lastly Zespri has implemented new technologies in their produce marketing/branding. For Zespri kiwifruit the implementation of these new marketing technologies relates to both quality control, but also more significantly, intellectual property protection. In relation to quality, the use of the specific fruit barcodes, helps to make fruit traceable. Meaning a specific fruit found at the end of the production ~~process~~ process such as the super market can be traced back to its grower. This provides additional means to identify quality issues that may be linked to growers. It also



serves the consumers increasing desire to know where their food comes from. However the more important purpose of this technology is its form of intellectual property protection against copy cats such as china. Zespri is facing a major intellectual property battle against china at the moment. China is illegally growing up to 5000 ha of Zespri sun gold kiwifruit. This poses a significant risk for zespri as ~~the~~ their product is supposed to be protected by a patent, preventing others from growing their cultivars. However china does not care for these patents, and is illegally growing their products. However since zespri cannot stop the growth of their products in china they have implemented a range of new branding technologies. As stated before zespri's brand its is built on its fruits quality. So when consumers see the zespri brand they associate it with quality. This is the advantage zespri has over china's producers. China does not have a good reputation for quality control or specific attention to detail. Zespri has accounted for this and anticipated that china will attempt to steal their branding. However the use of these new technologies <sup>such as barcoding</sup> make it much harder for china to do this effectively. Zespri plans that the use of the new barcoding technology will help to prevent the theft of the branding and hopefully avoid the confusing of consumers between high quality zespri products, and lower quality copy cat products.

## QUESTION TWO: The resilience of primary production systems to disruptive events

### PLANNING

Kmifruit

climatic -

political - banning hiccups by 2025, engine not as effective  
 economic - link to climate change as <sup>natural</sup> and breake is not as reliable  
 lack of government support

biological - covid, protectionism more tariffs, unable to distribute products

social -

Dairy

climatic - farm management plan, all farms over 20 ha

political -

economic - largest exporter 20% of NZ GDP  
 20B industry

biological - covid protectionism  
 ↳ decrease in exports from BOP - reached low not seen since 2002

social - waterways



Begin your answer to Question Two here:

ASSESSOR'S  
USE ONLY

The New Zealand Dairy Industry is New Zealand's biggest exporter with being valued at 20 Billion NZD in export revenue, 10B of which ~~went~~<sup>goes</sup> directly back into the NZ economy. Though dairy is such a big provider for New Zealand, it is facing a range of disruptive events that are putting its longterm sustainability at risk.

In relation to climatic events dairy is affected in a range of ways. Not only is dairy one of NZ's largest exporters, but it is also one of NZ's largest polluters (in relation to both emissions, and waterways). Due to dairy's 'dirty' image, and the changing social environment, political pressure has resulted in the implementation of farm management plans for any farm larger than 20ha. These plans are between farmers and the government, and they detail how resources can be used on a farm. The aim of these plans is to manage how ~~total~~ resources such as water and fertilisers are used in order to minimise any detrimental environmental impacts. However the implementation of these farm management plans will have a significant impact on the ability of farmers to produce their products. This <sup>at the same rate / quantity</sup> is because there is potential that the government will significantly limit the access growers have to necessary resources, and create fines, and penalties for those who violate rules / limitations. This would result in the ability of farmers to continue to produce at the same rate to be hindered. For example a dairy cow needs between 75-100L of water per day to produce 25-30L of milk. In addition <sup>to this</sup> a farmer may require water to irrigate crops such as foderbush or corn that are used as supplemental feed, or they may require water to ensure that their

pastures are maintained or to help establish riparian strips. However if their access to water is limited, then they will not have enough water to meet all their needs, something will have to go. This would likely have uneconomic impact on both the farmer, and ultimately the NZ economy. If a farmer doesn't have enough water for his needs does he get rid of his supplemental feed crop and buy in PKE? If they do ~~that~~ they may be at risk of losing out of premiums that are now offered by dairy manufacturers for not using PKE. So what if instead of getting rid of their supplemental feed crops they just give less water to their herd? Then the amount of milk produced will significantly decrease. The volume of milk produced by specific growers can be the difference between the price of their contracts. More reliable, high yield farmers will have better contracts, and more profits (up front) than less reliable, lower yield farmers. So reducing yield is not profitable. What if they reduce their herd numbers? This is somewhat the most viable option. Reducing the number of heads per herd can be beneficial for the farm land as it ~~reduces~~ <sup>reduces</sup> the damage to the land, it can also allow farmers to diversify their products e.g. dairy and horticulture. However this is not possible for all dairy farmers to do. The implementation of these farm management plans forces farmers to make cuts that will affect their productivity and profitability, due to NZ's dependence on the dairy industry their losses will also affect our economy. However ~~ultimately~~ it is important to remember that NZ dairy products can be sold at a premium price due to NZ's 'clean green image.' To continue to sell at these prices NZ must acknowledge to 'dirty' practices that are currently <sup>common</sup> ~~going~~ and innovate to create more sustainable production systems.



Another example of a disruptive event facing the dairy industry is Covid-19. This is an example of both a biologic disruptive event due to the viral nature of the Covid-19 pandemic, but more relevantly it is an example of a political and economic ~~societ~~ event. The Covid-19 pandemic posed a significant threat to dairy farmers, and their ability to get their product to market (market it). As the Covid-19 virus spread it resulted in a range of countries altering their border protection. It also resulted in international lockdowns. For many industries this meant they they produced their product and packaged it, to be exported, however once their exports reached the country of sale the products could not enter ports due to new restrictions. Or if they did enter the ports there ~~was~~ <sup>were</sup> no workers who ~~were~~ <sup>went back</sup> able to unload the products, and so as a result the products ~~went~~ <sup>went back</sup> off. This meant that their products could not ~~even~~ reach their market, despite reaching a packaged level. As these new regulations were being implemented out of genuine concern for the virus and to protect the individuals of each country. Some countries saw the implementation of these restrictions as a way to implement a form of protectionism for their country. New restrictions were created, additional tariffs were added, limits were generated, all with the purpose of ~~limiting~~ <sup>limiting</sup> imports from other countries. Fortunately New Zealand is a major exporter, and so we export to a range of different countries. This allows us to pivot from one exporter to another. However general protectionism has still been rising since the Covid-19 pandemic. This has been seen <sup>before</sup> with the UK and Europe with Brexit, and the US with Trump's policies. Fortunately New Zealand has a strong relationship with its exporters, and a significant point of ~~difference~~ difference of being clean & green. This puts NZ dairy



In a position of power in relation to our ability to stand against protectionism. Our resilience to this disruptive event is majorly due to our diverse number of exports to different countries, we would be in a much more vulnerable position if we were less diverse //



# QUESTION THREE: Freshwater management in New Zealand

## PLANNING

Dairy

economic - make it uneconomic

- Iwi/Māori culture tohunga

Social - right to use for recreation  
guardians of the land

maori

attempt to solve

Environmental - diffuse pollution - not known how bad it is yet  
point source pollution - identifiable pollution - targeted policy

- 76% of fresh water fish endangered

- 66% native birds

- exotics & other non-forms

Kiwifruit

- requires water at all stages of growth

could not produce economically without

- massive growth in exports, predicted growth - economic

N 110g/L



Begin your answer to Question Three here:

ASSESSOR'S  
USE ONLY

Both the New Zealand Dairy industry and the New Zealand Kiwifruit industry are significant exporters, that also require significant access to water. In New Zealand there is currently a major push for more legislation regarding fresh water and who has access to it. At the heart of this new legislation are three perspectives, the social and <sup>perspective</sup> ~~perspective~~, the environmental perspective, and the economic perspective, for both growers and NZ citizens.

There is no doubt that New Zealand has unhealthy water ways, this is a fact. 76% of fresh water fish are considered threatened, and a small number of fish such as the Canterbury mudfish are considered critically endangered. Connected to the health of aquatic life there is also a ~~decrease~~ significant decrease in fresh water way clarity, due to increased sedimentation. As a result increased weed growth, and a <sup>harsher</sup> ~~harer~~ environment for aquatic life. The addition of fertiliser run-off and leachage has resulted in rivers with unsafe levels of elements such as nitrogen. As these levels increase, weed growth and algal blooms increase with it. <sup>The majority</sup> ~~New~~ Zealand water ways are not swimmable, as they are unsafe for humans and pets, not only are they not suitable for us, but they are becoming unsuitable for organisms that are naturally found within them. NZ whitebait are endangered, with 3/5 of its species considered at risk. This is not only an environmental issue, but it is also a social and <sup>economic</sup> ~~change~~ issue.

Since NZ waterways are unswimmable it relates closely to Māori cultural values, and the NZ way of life. Māori believe

that waterways are theirs to guard and protect, and as a result they have the privilege to use them for recreational activities such as white bating, swimming, fishing etc. However this way of thinking has not been honored, and as a result the cultural tie that Māori have to waterways is at risk.

I believe this disregard for the cultural association to water has been overlooked due to the lack of measures that are publicised in relation to the freshwater quantity, and the impact this has on social well-being. Economic measures of success or failure are almost instant. It is easy to know if a product is profitable, within a short time frame. However in relation to water quality it can be much harder to accurately and instantaneously measure. This is because water quality is affected by both point source pollution such as dairy/cattle effluent and fertiliser run-off. But it is also affected by diffuse pollution. This is pollution that happens over time, such as leaching. The full impact of diffuse pollution is not known for decades later. This makes it hard to measure the direct impact of specific management practices. However policies have been put in place as a form of preventative future care.

In relation to dairy farming, there has been the implementation of riparian strips. These strips help to ~~limit~~<sup>limit</sup> the amount of run-off and sediment that enter waterways. These have proven to be effective. In relation to the kiwifruit industry there has been a plan to phase out bicane, a chemical agent used to irritate bud-breakers. This chemical agent has been shown to cause environmental harm specifically to aquatic life. This <sup>chemical agent</sup> is supposed to be phased out by 2025. The New Zealand government has also implemented



farm management plans in order to help overlook, and monitor the allocation of resources such as water for farms. Though these political interventions may have a positive environmental impact, they simultaneously have a negative economic impact.

As discussed before implementing farm management plans may have a detrimental impact on the ability for NZ dairy farmers to produce at the same level, and therefore they may not be able to produce to the same quality standards or reach the same yield. This will impact the total yield NZ has for export, and therefore NZ's total GDP. For the kiwi fruit industry the ban on bicane (hydrogen cyanamide) will <sup>create</sup> ~~have~~ significant issues for growers in relation to meeting industry timing, and quality requirements. If an effective bud break agent cannot be used, then the growth process will be thrown off for all orchards. This is because effective & uniform bud break, is what allows for uniform pollination, and therefore uniform growth, allowing growers to meet industry timing requirements. Growers have made it clear that without bicane their orchards are at risk of becoming uneconomic, and therefore going bust. Both the Dairy and Kiwifruit industry have stated that their economic sustainability are at risk, when environmental measures are put in place. So the question is, at what cost are these environmental measures worthwhile?

As these industries (dairy, kiwifruit) experience negative economic growth it will also have negative 'social-well being' impacts. The kiwifruit industry is projected to boom, with an increase of 29,000 jobs in the sector by 2030. These ~~jobs~~ <sup>jobs</sup> will be both domestic workers, and RSW (registered seasonal workers). As a result of more jobs, is more tax income, and less unemployment. Both positive



social and economic impacts. However ~~with~~ the growth projected, will be limited by these environmental measures. And so the policy that aims to improve the environment, and therefore improve social well-being will also reduce economic gain, and therefore reduce social wellbeing. This pull between these three factors has created tension between the government, growers/farmers and iwi.

As a result their new plan for fresh water management includes 50% of the committee being iwi members. This decision to include a māori and social perspective in the allocation of water has been criticised. However if all three <sup>interests</sup> ~~interested~~ are not share, then the social ~~an~~ or environmental aspect of this debate will be lost.

We can all agree economic success is important. Environmental conservation is in die need of attention. And that social well-being is an important factor in the conversation regarding fresh water. But what is more important, who decides this. Government, Farmers and Growers, or Iwi and the people of NZ? Current policies aim to give each perspective a voice, to make it equal. But are each of these outcomes equally important. Ideologically, yes. But realistically this is not possible, so how is the importance of each outcome measured, and by who. This is the current issue, that has caused tension between different parties.

## Scholarship Exemplar 2021

Subject	Agricultural and Horticultural Science		Standard	93105	Total score	13
Q	Score	Annotation				
1	5	The candidate has presented a well-structured, articulate, and insightful response to the question. The adoption of new technologies in the Kiwifruit industry has been effectively discussed and their relevant advantages and disadvantages analysed. The technologies discussed are across the wider primary production system – growing (irrigation, misting / frost control), processing (pack house automation), and distribution / marketing (controlled atmospheres, barcoding).				
2	3	In this question, the candidate has not addressed the question in a fully coherent, structured manner. While the discussion around the implications of the Covid epidemic are valid, the discussion around the environmental issues facing dairy farmers and the challenges of farm management plans and other imposed requirements are less clearly discussed and linked to the question.				
3	5	In this question, Dairy and Kiwifruit production systems have been used as the contexts to discuss freshwater management. The cultural 'value' of water has been articulately discussed and the tensions between obvious economic benefits and less 'measurable' 'social wellbeing' indicators.  Iwi presence on water management committees represent a 'management' response to these tensions. Overall, an insightful discussion to the question and at the Scholarship level.				