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OUTSTANDING

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Scholarship 2018
Agricultural and Horticultural Science

2.00 p.m. Friday 9 November 2018
Time allowed: Three hours
Total marks: 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.

Write your answers in this booklet.

Start your planning and answers to Questions One, Two, and Three from pages 2, 8, and 14, respectively.

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 2–24 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

Ever since the evolution of man protein has been essential in human's diet. Throughout caveman time right through to today meat, nuts and eggs have been the main source of this protein and this is recognised in our traditional food pyramid as being an essential component in our everyday diets. On average a human will consume protein in two meals of the day and even more in developed countries. In today's world we eat too much protein whether it is 350g steaks or large portion of poultry, experts say that women should consume 40-50g protein and men 50-60g of protein. So why do we continue to eat so much meat? and how is this sustainable?

Millennials are driving change away from traditional diets and new trends such as vegans and flexitarians are driving massive movements away from traditional protein sources. This issue has developed exponentially around the world in the last 10 years and is now labelled a mega-trend and this change has been driven by three global issues: animal welfare, environmental issues and global warming. These three issues are being highlighted around the world through social media. In terms of the mega-trend of people moving away from traditional protein sources social media has acted as a catalyst to peoples' personal values and beliefs of how we as humans have traditionally eaten proteins and what it is, we are eating. More often than not, opinionated articles receive a ridiculous amount of support online on the negative impacts of traditional protein production whether it's ethics, animal welfare, water pollution, land use, cultural values or greenhouse gas emissions. People in today's world are no longer happy with traditional proteins. This is driving a massive consumer demand for alternative proteins. And the industry is beginning to meet these requirements.

Firstly, I will look into natural alternative proteins and how technology is being used to make natural proteins into a sustainable food source. Insects are eaten by humans traditionally by 60% of the world's population. However, this is unheard of in developed countries. The CEO of Proti Farms in the USA is the industries fore father in the commercialisation of insect- based protein production. His business. Proti Farms produce 120 different species of insects and worms as food grade protein sources. He says, "insect- based protein can be used in over 2100 different applications in replacement of traditional protein, our insects use hardly any land, very little water, produce hardly any greenhouse gases and can yield up to 90% protein from what they eat". This is revolutionising alternative protein and his business is expanding rapidly to keep up with consumer demand. He says, "that 100 lbs of grain will yield 5 lbs of beef however give the same amount of grain to crickets or mealworms and they will yield between 60 and 90 lbs of protein, making them way more efficient and affordable." Some of the insects produced can be ground and stored as pure protein creating an opportunity to mass store protein for food shortages. This is one example of an innovative alternative protein-based food which is meeting the market demands for alternative proteins different to traditional protein.

Another natural alternative protein is animal free milk which is using traditional proteins such as nuts and beans to make a dairy milk replacement. Both soy milk and almond milk are hugely popular around the world after the negative impacts of

dairy production have been illustrated all around the world and the fact that people are beginning to realise why we are so stuck in our ways and why we always do what we have always done. Why do we as adults still drink milk when is a liquid protein from mammary glands of mammals to raise new born, how come we have never been weaned off milk? Health and nutrition expert Ana Ward says "almond milk and soy milk are a great alternative which have many vitamins and minerals for diet supplements and are good alternatives for people with allergies or health problems and are much better for you than dairy milk". These alternative milks cause minimal damage to the environment and animal welfare so are becoming hugely popular as an alternative protein food product.

The other type of alternative proteins is the synthetic meats. Firstly, I will talk about clean meat. Memphis Meats in the USA are funded by Bill Gates and Richard Branson have developed a clean meat which is laboratory produced in petri dishes as an alternative protein to replace traditional red meats. Fi Dalgeiti, Agri Woman's Development Trust spokesperson says that "the world's population will increase y 2.3 billion people by 2050 and it is impossible to feed the world on traditional meat therefore there is a huge demand which is growing world wide for alternative meat protein and Memphis Meats is one example leading the way with new technology". In 2017 the laboratory produced meat was worth $58 000/lb and in the last month is now worth $1.99/lb. Tis shows how economies of scale have decreased the cost of this new alternative making it very affordable and due to its accessibility will by one of the innovative ways in which we will feed the world in the future.

The second synthetic meat is the Impossible Burger which was worth $80 million for the first one produced in 2017 and now worth $20/kg. The Impossible Burger patty is made of plant- based material and is engineered in a laboratory to meet the five senses of cooking red meat. This patty has haemoglobin extract from chickpea skins to make it taste like meat, it also has coconut oil to give the sizzling sensation of cooking meat. This patty literally also bleeds, it is so similar to the real thing some Americans say they cannot taste the difference and without causing any problems to the environment or offending anyone's personal values it is a sustainable alternative protein which is taking the world by storm.

The alternative proteins talked about above pose both a risk and an opportunity to New Zealand's red meat sector. Sam McIvor Beef & Lamb CEO says that "this is the biggest disruption the industry has faced since the 1980's when lambs were worth $4, and ewes were worth 50c if you could get the killing space. Sam recognises the massive risk these alternative proteins have on the industry but also recognises a unique opportunity for the red meat sector in NZ to change its' traditional business model away from producing meat as a commodity but turning it into a luxury product that will no longer be eaten five nights a week in homes in developed countries but it will become a luxury which will be consumed one to two times a week so this is why we need to add value to our products so they are recognised as a luxury in the overseas market. This is because we have limited land for agricultural production and with the world' population increasing so much in the next 30 years to feed the population on agricultural meat products is impossible and not sustainable. From my interview with Fi Dalgeiti last night she said New Zealand's only chance is to stop

trying to supply 20% of the world's meat but we should be targeting 3% in developed countries for twice the price. Sam also says that it is about turning the red meat into a premium, so it does not have to compete with alternative protein- based products. Matt Ward owner of Mt Erin Exports Ltd. Says that "synthetic proteins will never replace red meat because there will always be demand for the real thing. He said no matter how advance technology becomes they will never be able to replicate a porterhouse steak, dry aged with 20% core fat marbling "and he is not worried at all about the future of his meat export business as there will always be someone willing to import NZ's beef and lamb. Earlier this year Air NZ served the impossible burger on one of their flights Auckland to Los Angeles and Mark Patterson, NZ Agri First spokesman said, "that it was a slap to the face for the red meat industry as our national carrier should be show casing our premium grass- fed natural beef and lamb". Nathan Guy said that "it was ridiculous that a genetically engineered protein was served in front of world leading GMO-free red meat".

Mike Petersen who is on the board for Canterbury Meat Packers Brand recognises that our red meat production is not sustainable and will not be able to feed the increase in population and he is happy that alternative proteins are taking over the protein commodity.

I think personally there are both threats and opportunities created through the development of alternative- protein- based meat. Technology is developing faster than you or I know and with agricultural exports being our second biggest export earner, behind tourism, and employing hundreds of thousands of jobs nation wide we need to embrace the risk and address environmental issues especially with water pollution and greenhouse gas emissions and make sure that our traditional protein that we produce is the best in the world and is ethically produced with things like animal welfare and efficient land use becomes a priority for country so we can differentiate our meat from mass producers like South America and USA. A wise man once said, "to embrace change is innovation in itself".

Question Two

Water is said to be New Zealand's greatest natural resource. It is seen through many different eyes from different groups throughout the government whether it is spiritual, a recreational resource, an input in primary industry production or just in general a right Kiwis have to enjoy drinking unfiltered natural water. But is it as good as it seems? I will be discussing the value of water to our economy through dairy and agriculture as well as looking at the social and cultural views on water and lastly looking at the environmental impact our agricultural industry is having on our greatest natural resource.

White gold – New Zealand's diary industry which has boomed in the last 15 years as NZ jumped on the opportunity to meet the worlds demand for dairy products y creating the supply. Over the last 20 years 100's and 100's of sheep and beef farms have been converted to dairy. In Canterbury, Southland, Taranaki and the Waikato dairy farms have become over intensive as farmers have chased pay-outs by increasing kg's of milk solids that their farm produces. But has it come at a cost? In 2016 dairy was worth $13.2 billion to our economy through dairy exports and was our biggest export earner. In NZ's industry economic report, published by the government in compilation with MPI that dairy provides over 40 000 kiwis and is the second highest wage in the agricultural industry. So how has NZ suddenly become one of the world's biggest exporters and the answer is water. Water has been over applied and exploited to an irreversible extent in our industry. But is it all worth it? As our economy thrives thanks to the GDP provided by our dairy production. Jarrod Fritchley said that through his discussions with Fonterra, Fonterra's Marketing Manager said that a $1 increase in a dairy pay-out will increase our GDP by $2000 per household and as much as $600 per person. This is due to circular flow in the economy and how dairy generates so much value for our economy through its operations in NZ. Our current dairy production level has only been possible through our access to water. Having access to water has turned unusable land for dairy into some of NZ's dairy farms in the Canterbury region. Where water is applied at an unsustainable rate however the country is thriving, so how is this possible? Andrew Curtis Irrigation NZ CEO says that "irrigation is worth $5.5 billion to our economy, the majority of which has come through dairy". So technically our economy needs our water for our agricultural use so the value of water by economic groups is seen as an input rather than a resource. Another example of how our water is being exploited is the bottling of our fresh water by overseas businesses which is then exported offshore tax-free. However, the jobs created in these plants and the money earnt in the economy by allowing businesses to export our water is generating jobs and value in our economy, so it is also seen by government and some regional councils as high value resource which can be used to benefit the economy.

The social value of water is very very different to the views of groups involved with the benefit it reaps for the economy. Socially water has a non- money value for your average Kiwi, but water is seen as a right we have to use for recreational purposes as well as simply drinking our clean fresh water. But is this being disrupted by farmers polluting our waterways for economical benefits. Fish & Game are great example of a group who represents Kiwi's who enjoy the outdoors as they fight

governments and regional council to restrict water use through consents and RMA's to prevent the exploitation of our water which everyone is entitled to. They believe our pristine clean rivers and lakes should not be tarnished by agricultural production and should remain unpolluted for trout, salmon, wildlife (introduced and native) to thrive in our natural environment. However regardless if you are a trout fisherman or a duck shooter your average Kiwi should have the opportunity to drive out of town and swim and enjoy our pristine water. However due to agricultural pollution 2/3 of our rivers are un-swimmable and ½ our lakes have irreversible pollution. For a country that prides itself on our 'clean green image' we are not achieving this title. As we have a right to clean water but however as we have seen through the Havelock North water crisis, Campylobacter sp. polluted residence water supply causing three deaths and 3000 people sick. This was allegedly was from farming practises which lead to this contamination.

Another dimension of the social values of water is cultural and how the Maori people have their indigenous spiritual beliefs of water. As been the first race of people to call Aotearoa home they believe water has mauri, which means their ancestors flow through it and they alone as shepherds of the land own the water resource. They think Aotearoa, or Mother Earth, is a living being and the rivers and streams being her blood and veins. They are very offended when our water is shipped overseas but even more importantly is polluted by agriculture. However, in 2014 some tribes took to the government and courts a proposal to rid all water consents in NZ and entitling the Maori people to all the water rights in NZ where the rights to the rights to the water would have to be bought off them. This was seen by many Kiwi's as a greedy move to generate money for their tribes. However, this the value they hold and to this day Maori people do own a lot of water bodies and control how it is used. For example the chairman of Lake Rotorua, Lake Rotoiti and Lake Rotoma said that "his people have been living on the lake front ever since they first came to NZ and they have strong connection to the water through their ancestors and that the pollution that the dairy farms in the Waikato is causing to the lakes is very saddening".

There are many different opinions from different groups, of the value of water from social groups and economic groups but the most important value of water would have to be the environmental topic which is controversially discussed by both groups above. It is a fact that we are degrading our environment by polluting our water. Peter Fraser NZ Dairy Economist said that "one cow is the equivalent to 14 humans in terms of pollution to water so effectively NZ has a polluting population of 90 000 000 people the same as Japan and that dairy production in a year uses the same amount of water in NZ as 60 000 000 people would use in a year as it takes 1000 of water to make 1 litre of milk and due to dairy production being so intensive we are polluting our water way more than we should be. William Benfield, author of Water Quality NZ, stated in his book 95% of water pollution in Canterbury is caused by dairy and Greenpeace NZ published that 2/3 of our rivers are un-swimmable and 1/2 our lakes are having irreversible amounts of pollution. From my interview with Mike Joy, fresh water ecologist , he told me that dairy is the main cause for water pollution and this lead him to develop the MCI which is the Macro Invertebrate Community index which measures the insect life in our water ways over a long period of time and

his study confirmed that 90% of our water ways are polluted and that 40% of these are high risk and causing possible extinction to native fish species due to the poor water quality.

Alison Dewes who is a scientist who wrote a thesis on dairy farming concluded that we can reduce our stocking rates by up to 30% and achieve the same level of profitability in NZ's dairy industry. As we can see in graph one [in answer booklet page 9] we are currently operating at maximum profit which is high risk as farmers are chasing the highest milk solids possible but we could sustainably produce at the minimum risk line where we would have the same amount of profit for less risk and a lot less stock producing less milk solids and less impact to the environment similar to in graph two where we should be producing at point 1 on the graph where revenue would technically equal the same as it is now as we would have less fertiliser and water imports with smaller stocking rate and achieve the same amount of profitability as where we currently sit at point 2 where we have a huge amount of imports as farmers chase quantity over quality.

For these reasons the environmental value of water is the priority and should be for all parties, so we can clean it up for everyone to enjoy rather than it being exploited by the agriculture industry. All these different views above illustrate different opinions as everyone is pushing an agenda and the social and cultural groups need to sit down with people in the primary industries and come to an agreement that puts environmental and the quality of the water first so that our clean green image is preserved for generations to come.

Question Three

It would be fair to say as agricultural products being NZ's second biggest export earners is high output and low value as it is mass exported as a commodity. With the world changing at such a rapid rate there are entrepreneurs in the red meat sector and the apple industry who are innovating what they do in their production systems to target high value niche markets receiving premiums beyond the large-scale production of your average farmer and orchardist in NZ.

Firstly, I would like to look at a business in Hawke's Bay who are marketing their products a lot differently to the average farmer in the red meat sector. They are changing what their business model looks like to target high value niche market to differentiate themselves from the average farmer and the average meat works. Duncan and Annabel Smith owners of Patongata Station and Waipawa have developed a new business model and are reaping the rewards of creating a high value product. Central Hawkes' Bay farmer Duncan Smith has moved away from his coastal high- country property at Omakere to the irrigated river flats of Patongata where he no longer has breeding stock ut buys in lams and Angus heifers that he can fatten all year around. Duncan only farms Sufftex ewe lambs and 2 year Angus heifers of which he kills 20% of these for the Waipawa butchery which he now owns and is run by his wife Annabel. Progressive Meats in Hawke's Bay kill 30 lambs / week and 8 heifers all of which are sold at the Waipawa butchery and their pop-up shops at Farmer's Markets in Palmerston North, Dannevirke and Napier. The Waipawa butchery now employs 17 people and they market and sell Duncan's animals for a premium price gaining up to 30% more per kilogram for both their beef and lamb. Firstly, how their lamb is different forn your average farmer. Duncan only puts terminal Sufftex breed of lambs which have less fat cover and are slower growing which have better meat quality through his operation and only ewe lambs will be sold through the Waipawa butchery operation as they have less hormones and are a more consistent product. All lamb sold trough the butchery is of this quality and will be hung for 5 days to age the lambs are also at a weight range of 18-24 kg to ensure they are not over fat. This is a lot different to high production in other meat works where the product is frozen straight away. The Angus heifers are also aged for 18 days and Duncan says 90% of his beef would meet P1quality so it is the highest quality possible. He does not use huntaway's only heading dogs and in doing so his beef will be 0.3% less pH than other P1 quality beef in NZ setting him apart from average farmers. He has partnered his meat production with only top-quality restaurants, such as Craggy Range and he says partnering with the best brands in Hawke's Bay is a way of marketing his beef and lamb as a way of differentiating it from less quality competitors. On the menus and the butchery as well as the pop-up shops this story is told of the Smith's unique family farm which entices people into the shop for the first time but then the consistency and the quality and the traceability brings these customers back week after week says Duncan. This is how Duncan and Annabel have changed the way the run their from previously sending ll their stock to the meat works for a flat rate they now draft out their top 20% of heifers and lambs to be sold through their new family business which is their butchery targeting a high value niche product. This is a distinct from the mass production of beef and lamb

exports as commodities. Annabel says that "by having the opportunity their customers face-to-face at the farmers market it is a unique opportunity to explain indetail why their meat is produced a lot differently to the average farmer". They also provide taste testing of their meat as a way of interacting with their consumers and this is a highly effective way of marketing and she says, "within the week more often than not these people will be walking through the door at the butchery". By Duncan having the opportunity to having irrigated land he can sow plantain and clover which generate very good yields of his stock as it is a very high source of food and high metabolic energy. This has allowed him to move away from holding breeding stock and given him the opportunity to buy and fatten the Sufftex lambs and the heifers of which he can hand pick the best quality stock to make it to the butchery where the rest of the stock are killed with Progressive Meats for the export markets. The interesting thing I found through my investigation of Patongata Station and Waipawa butchery is that the Smith's have no intention to further expand or increase the size of their operation as they say they would lose their sense of gate-to-plate and being horizontally integrated by providing their unique beef and lamb of the highest quality to a niche luxury market in the Hawke's Bay.

My second example of another primary production system is Rockit Apples who have created a global brand by differentiating their apples away from the commodity and high quantity NZ exports. Hawke's Bay entrepreneur Mr Fraser created the Rockit Apples business model of which he grew a new variety of apples which were approximately 1.5 times the size of a golf ball and very sweet in taste of which are packed into tubes and sold overseas as a snack. This business model is a very high-end niche market overseas as he has developed an idea into a multi-million-dollar business who now exports apples to supermarkets all over the world. Mr Fraser said "he was sick of his apples having to compete with other apples from all over the world in the commodity market". His idea of the Rockit apples was that they would be sold with the confectionary and snacks at the check-out in super markets not in the fruit and vegetable section. By having a small sweet apple, it is no longer a big meal as Asians see a normal apple but as a snack that was small and ergonomic for consumers to eat and by having a high Brix level they wert very sweet and appetizing as a snack. Rockit apples were sold in a sealed tube which was very pleasing for customers in Europe and Asia as biosecurity is very strict and food safety is their priority. By having apples in a sealed container there was no chance that bugs or decay of the fruit, meaning that they were clean and very presentable when on shelf. As the company grew up to 300% in size and value so did the ideas and not long after Rockit apples were being sold in cafes , airports and vending machines, and of cause at a premium price. This shows how one man's idea can differentiate an apple from an apple. What I mean by this by starting with the variety the packaging and where and how it is sold into the market it created a high-end product a lot different to your normal to your box of apples that is exported overseas.

Both the Waipawa Butchery and Rockit Apples are a great example of how two primary production systems have differentiated themselves from the mass production for New Zealand exports. My critical analysis for the Waipawa Butchery being superior to your average meat works in NZ is that normal meat works freeze

their products as soon as they are off the line. Mike Petersen talks about this process is a kill-step as value can no longer be added after this product has been frozen Similar to drying milk into milk powder, it is an irreversible step. This created the opportunity for the Smith's to differentiate their meat by not only ageing it but having the ability to choose the breeds, the sex and the weight of the animals they are putting through the butchery.

Apart from Rockit Apples a normal apple which goes to overseas market is no different to an apple produced in Chile or Asia. We can currently only focus on the quality of the apple we produce to receive a premium in the commodity market however Rockit Apples have taken this to a new level by no longer competing with other apples in the mass production of the commodity.

These two businesses were both ideas of innovative entrepreneurs who developed new business models away from most primary production systems which focus on the large- scale production but they have now targeted a niche market opportunity and receiving the highest prices possible.

Outstanding Scholarship Exemplar 2018

Subject	Scholarship – Agricultural and Horticultural Science	Standard	93105	Overall grade	19

Q	Grade	Annotation
1	O7	The candidate has presented a well-structured, articulate and insightful response to the question. The drivers of the change are articulately presented as are examples of the alternative proteins themselves. The opportunities and threats that this movement presents to New Zealand have been identified and includes perceptive elements (e.g. the significance of new technologies to the development of these new foods).
2	O7	The candidate has presented a clear and well-reasoned analysis of the perspectives various groups have towards water. Its role in the expansion and significance of the dairy industry is clearly articulated and goes beyond the benefits at the farm gate. The social and cultural values of water are also well presented and evaluated, with appropriate references to scientists and data. The conflicts that water allocation and use create are discussed in detail and in an accurate, balanced way. The clarity of discussion and perception support the awarding of a 7 – a little more integration of the issue with primary production systems would have allowed an 8 to be awarded.
3	S5	The candidate chose the red meat sector (lamb and beef) and apples as the two primary production systems to discuss in terms of their ability to produce and market new, high value niche products vs the mass production of commodities. For the purpose of marking the question, beef and lamb have been considered as two, distinct primary production systems. The evaluation of the beef and lamb systems is rather narrow – focussing on an example of the Patongata Station's vertically integrated system from paddock to plate, including the marking aspects. While this is an excellent and well discussed, detailed example of innovative marketing that is outside the norm, the focus of the answer needed to be broader. The apple production system has also focussed on a specific example within the broader apple industry – Rockit Apples. As with the evaluation of lamb and beef, the discussion of Rockit apples is very good. However, to gain full reward, wider industry aspects, opportunities, constraints, etc needed to be included. The depth, clarity and structure of the discussion of the examples presented warrants the awarding of a scholarship level answer but at the lower end – 5.