Assessment Schedule – 2018

Agricultural and Horticultural Science: Demonstrate understanding of land use for primary production in New Zealand (91297)

Evidence Statement

Question ONE: Changes in land use on the Central Plateau

Achievement	Achievement with Merit	Achievement with Excellence
Explains why land around the Central Plateau has traditionally been used for forestry. *OR* **Explains** why the decision to scale back the conversion of land from forestry to dairy farming was made.	**Explains in detail** why the decision to scale back the conversion of land from forestry to dairy farming was made.	**Justifies** the decision to scale back the conversion of land from forestry to dairy farming by **comparing and contrasting** these two land uses.

N0	No response; no relevant evidence.
N1	Some writing, but does not explain why land around the Central Plateau has traditionally been used for forestry, or why the decision to scale back the conversion of forestry land to dairy farming was made.
N2	Partial or insufficient explanation of why land around the Central Plateau has traditionally been used for forestry, or why the decision to scale back the conversion of forestry land to dairy farming was made.
A3	**Explains** why land around the Central Plateau has traditionally been used for forestry, *OR* why the decision to scale back the conversion of forestry land to dairy farming was made.
A4	**Explains** why land around the Central Plateau has traditionally been used for forestry, *AND* why the decision to scale back the conversion of forestry land to dairy farming was made.
M5	**Explains in detail** why the decision to scale back the conversion of forestry land to dairy farming was made, with reference to ONE factor.
M6	**Explains in detail** why the decision to scale back the conversion of forestry land to dairy farming was made, with reference to TWO factors.
E7	**Justifies** the decision to scale back the conversion of forestry land to dairy farming by comparing and contrasting these two land uses. Comprehensive evidence given for ONE factor.
E8	**Justifies** the decision to scale back the conversion of forestry land to dairy farming by comparing and contrasting these two land uses. Comprehensive evidence given for TWO factors, with another factor well supported.

Q1	Evidence
(a)	**Explains** why land around the Central Plateau has traditionally been used for forestry. Native forest was cleared from the Central Plateau in the 19th century. When farmers tried to convert the land to pasture, ruminant stock suffered from bush sickness, which was later diagnosed as cobalt deficiency. Pinus radiata was found to grow well in the thin pumice soils, and was planted extensively across the Central Plateau. It was not until the 1930s that the cobalt deficiency was diagnosed, by which stage more than 400,000 hectares had been planted in forests. The exotic forestry was also needed to replace the native forestry, to supply timber to the growing towns and cities of New Zealand.
(b)	**Justifies** the decision to scale back the conversion of forestry land to dairy farming by comparing and contrasting these two land uses. *Economy* **For Merit:** The drop in dairy prices in 2015 from over $8/kg to just over $4/kg has reduced the viability of dairy farm conversions. The conversion from forestry to dairy incurs significant upfront costs. The cost of a dairy cow can be in excess of $2,000, with milking sheds, effluent ponds, and irrigation all adding to the establishment cost. The rehabilitation of forestry land to dairy can also be significant. **For Excellence:** Dairy prices are highly volatile – in recent years, milksolid payouts have ranged from over $8/kg to under $5/kg. In high payout years, farmers contribute large amounts to the local economy, upgrading equipment and employing staff. In low payout years, farmers reduce spending and the local economy suffers. Due to the longer timeframes with forestry and the reduced volatility of timber prices, returns to the local economy are more consistent. However, forestry often does not return income until the forests are harvested, which can be 25 years or more after planting. Dairy farms can start producing an income in as little as a year. Dairy farms have, on average, a higher return per hectare than forestry ($40,000+ per year for dairy, compared with $25,000 per year for forestry). Both forestry and dairying require a large workforce, often in areas with high unemployment; in the past, these tended to be low-skilled employees, but they are increasingly becoming more skilled. These employees contribute heavily to local economies. Profitability of dairy farms is highly dependent on the cost of inputs, such as fertilisers, and the price of its outputs (milksolids). Due to the nature of milk products, it is difficult to stockpile them and wait until dairy prices increase, but with forestry, harvesting can be delayed until prices improve, if necessary. *The environment* **For Merit:** The high profile “dirty dairying” campaign, which began in the early 2000s and continues today, has led to a public backlash against large-scale dairy conversions. The thin pumice soils of the Central Plateau are free-draining and are at high risk of leaching. The downstream catchment in the Waikato is already under pressure from nutrient enrichment and effluent. As the issue of climate change has risen in the public’s eye, converting large-scale forestry carbon sinks into sources of carbon emissions such as dairy farms has led to protests from the public and put pressure on regional councils. Also, as Landcorp is a state-owned enterprise, it is under considerable political pressure to be environmentally conscientious. **For Excellence:** Dairying has negative impacts on the environment, with the two main issues being nutrient enrichment of waterways through fertiliser / effluent runoff and carbon emissions. Effluent and nutrient runoff are contributing to the eutrophication of waterways and lakes. While modern farming practices have reduced effluent and nutrient runoff, they have not eliminated it. As dairy farms have become more productive and intensive, carbon emissions have increased in the form of methane. Half of New Zealand’s carbon emissions come from agriculture, including dairy. Forests, while they are growing, act as a carbon sink. When they are harvested, trees stop absorbing CO_2 and the forests need to be replanted to continue absorbing this gas. Provided the timber is not burned, the carbon continues to be locked up for the life of the wood product. Harvesting of timber needs to be done with care, to prevent erosion of the exposed land. Pine forestry is a monoculture and only supports some native species.

	Social aspects The area around the Central Plateau is a major tourist destination for both domestic and international visitors. Due to the nature of dairy farms, it can be difficult to allow public access to a working farm, whereas forestry operations can be opened up to recreational activities and become tourist destinations in their own right. This can also give forestry owners an income stream before the timber is harvested. The public perception of dairy farms in New Zealand is quite poor, especially among those without a farming background. Due to marketing campaigns from organisations such as SAFE and Greenpeace, dairy farms are now under a lot of scrutiny. Forestry, however, is largely seen in a positive light, especially in terms of land use and the environment.

Question TWO: Avocados

Achievement	Achievement with Merit	Achievement with Excellence
Explains the traditional land use in Northland. *OR* Explains how Northland's environmental and economic factors are suitable for subtropical fruit.	**Explains in detail** why Northland's environmental and economic conditions are suitable for subtropical fruit.	**Evaluates** the impact of conversion from traditional land use to avocado orchards in Northland.

N0	No response; no relevant evidence.
N1	Some writing, but does not explain a traditional land use in Northland, or how Northland's environmental and economic factors are suitable for subtropical fruit.
N2	Partial or insufficient description of a traditional land use in Northland, or how Northland's environmental or economic factors are suitable for subtropical fruit.
A3	**Explains** a traditional land use in Northland, *OR* why Northland's environmental or economic factors are suitable for subtropical fruit.
A4	**Explains** a traditional land use in Northland, *AND* why Northland's environmental or economic conditions are suitable for subtropical fruit.
M5	**Explains in detail** why Northland's environmental *OR* economic conditions are suitable for subtropical fruit.
M6	**Explains in detail** why Northland's environmental *AND* economic factors are suitable for subtropical fruit. Uses examples to support statements.
E7	**Evaluates** the impact of conversion from traditional land use to avocado orchards in Northland. Comprehensive evidence given for ONE factor.
E8	**Evaluates** the impact of conversion from traditional land use to avocado orchards in Northland. Comprehensive supporting evidence given for TWO factors.

Q2	Evidence
(a)	**Identifies** a traditional land use in Northland / **Explains** reasons for this land use. Over the past century, Northland's main agricultural land uses have been dairy, sheep, and beef. At one time, Northland had nearly 25% of New Zealand's dairy cows. Northland has been an important citrus-growing region since the 1920s, especially in the area around Kerikeri. Northland's agricultural land use has been largely driven by its subtropical climate, with few winter frosts and high sunshine hours. Poor soil fertility has limited the intensification of dairying to the more fertile lowlands of the region.
(b)	**Explains** why Northland's environmental or economic conditions are suitable for subtropical fruit. Warm growing conditions, and workers experienced with orchards. **Explains in detail** why Northland's environmental or economic conditions are suitable for subtropical fruit. *Environmental* Northland has some of the highest sunshine hours in New Zealand, with a high number of heat units; this allows long growing seasons, which suits fruits that grow best in subtropical regions. The coastal climate limits low winter temperatures and frosts, preventing damage to subtropical fruit. The high rainfall and sandy, well-draining soils provide ideal growing conditions. *Economic* Northland has access to two major international ports, as well as good transport links to Auckland and its international airport. This allows quick access to both domestic and international markets. Northland has a well-developed fruit-picking and processing industry and relatively high unemployment, which provides a ready supply of unskilled workers.
(c)	**Evaluates** the impact of conversion of a traditional land use to avocado orchards in Northland. *The economy* Global and domestic demand for avocados has increased, due to the fruit being widely seen as a "super fruit". With the volatility in dairy prices, avocados are considered by some as a safer investment. The return on avocados per hectare is greater than for dairy ($50,000 per hectare vs $40,000 for dairy). Also, inputs for dairy farming are increasing, as is global competition in the dairy sector. Avocados have a long lead time, taking 3–4 years before an income can be realised, and a typical orchard will not operate at full capacity until after seven years. The diversification of New Zealand exports away from dairy boosts the New Zealand economy's resilience. The domestic market for avocados is large, and Northland is located close to our largest city, giving it easy access to substantial local markets. Also, Northland has two major ports which provide access to international markets. Theft of avocado crops is having an impact on income in Northland. *Workforce supply* Northland has an established horticultural workforce experienced in the harvesting of kiwifruit and citrus. These skills can be transferred to the harvesting and management of avocados. Existing packing sheds used for citrus can be adapted for avocados and used in the citrus off-season. Unemployment in Northland is relatively high, and fruit harvesting is relatively low-skilled work, unlike many dairy farming jobs. Northland also sees large numbers of tourists on working holidays who seek out harvesting jobs.

	Environment As dairy farms have intensified over the years, treatment and disposal of effluent has become difficult and water quality has declined. In 2002, the Fish and Game Council launched a dirty dairying campaign to highlight the damage done to waterways in New Zealand by intensive dairy farming. This and other campaigns have led to Regional Councils setting strict water quality standards and prosecuting farmers who are not compliant. In 2017, nearly a third of Northland's dairy farms were non-compliant with limits imposed on effluent discharge. Dairy farms are also a significant source of New Zealand's carbon emissions (nearly 25% of the national total). Conversion from dairy farming to avocado orchards would reduce the amount of effluent needed to be disposed of in Northland, improving water quality. Reducing the number of dairy cows in Northland would also reduce the amount of carbon in the form of methane released, and as trees absorb carbon from the atmosphere, replacing dairy farms with avocado orchards would reduce the net amount of carbon released in New Zealand.

Question THREE: Irrigation

Achievement	Achievement with Merit	Achievement with Excellence
Explains the main agricultural and horticultural uses of land in the Central Otago region. *OR* **Explains** how irrigation technology has allowed land use to change.	**Explains** in detail the reasons behind the main agricultural and horticultural uses of land in the Central Otago region. *OR* **Explains** in detail how irrigation technology has allowed land use to change in the Central Otago region.	**Discusses** the expansion of irrigation.

N0	No response; no relevant evidence.
N1	Some writing, but does not explain the main agricultural and horticultural uses of land in the Central Otago region, or how irrigation technology has allowed land use to change.
N2	Partial or insufficient response that does not explain the main agricultural and horticultural uses of land in the Central Otago region, or how irrigation technology has allowed land use to change.
A3	**Explains** the main agricultural and horticultural uses of land in the Central Otago region, *OR* how irrigation technology has allowed land use to change.
A4	**Explains** the main agricultural and horticultural uses of land in the Central Otago region, *AND* how irrigation technology has allowed land use to change.
M5	**Explains in detail** the reasons behind the main agricultural and horticultural uses of land in the Central Otago region, *OR* how technology has allowed land use to change in the Central Otago region.
M6	**Explains in detail** the reasons behind the main agricultural and horticultural uses of land in the Central Otago region, *AND* how technology has allowed land use to change in the Central Otago region.
E7	**Discusses** the expansion of irrigation. Comprehensive evidence given for ONE factor, with one other factor well supported.
E8	**Discusses** the expansion of irrigation. Comprehensive evidence given for TWO factors.

Q3	Evidence
(a)	**Identifies** the main agricultural and horticultural uses of land in the Central Otago region / **Explains** the reasons behind these uses. Horticulture – Vineyards, stone fruit, and pip fruit. Agriculture – Sheep / beef, with new conversions to dairy. Central Otago has a semi-continental climate, with warm, dry summers and temperatures that can exceed 30°C, and cold winters. These environmental conditions match those needed by stone fruit and pip fruit. The cold winters help prevent diseases, and the warm, dry summers are ideal for ripening fruit. Central Otago has old, free-draining soil rich in minerals, which supports good growth. The low rainfall and high evaporation in summer means that without extensive irrigation, the land is unsuitable for intensive agricultural uses such as dairying. Because of this, land unsuitable for horticulture is mainly used for sheep and beef at low stocking rates.
(b)	**Explains** how irrigation technology has allowed land use to change**.** The Central Otago area has a large number of water races that were originally built for gold mining. These races were supplemented in the 1930s by water-storage dams. These water sources have been used by farmers to irrigate their farms, using flood irrigation. Flood irrigation, while effective in certain areas, is not an efficient irrigation method. New irrigation methods, such as centre pivot, drip, and traversing irrigation units are much more effective and allow a greater area of land to be irrigated. Due to the climate conditions in Central Otago, the land has a soil moisture deficit in summer, making it unsuitable for agricultural and horticultural purposes without irrigation. New technology, especially from the 2000s onwards, such as new sprinkler technology, irrigation scheduling, and precision agriculture, has provided a step change in water efficiency. This has allowed water-intensive land uses such as dairying.
(c)	**Discusses** the expansion of irrigation. *Environment* Irrigation can have both positive and negative impacts on the environment. The bare land in the Central Otago region is susceptible to wind erosion when dry. There are reports of up to 2.2 tonnes of soil being lost per hectare, per year. Irrigation reduces the amount of bare ground, reducing the risk of erosion. Irrigation can enhance biodiversity values, allowing a greater number and diversity of native organisms to survive in the area. However, when land is irrigated, the existing semi-arid habitats are lost and existing species cannot always survive by adapting to the new habitat. Loss of these tussock habitats is a real threat. An increase in irrigation increases the risk of contamination of ground and surface water with nutrients and pathogens. An increase in nitrogen leaching can result in eutrophication in water downstream from the irrigated areas. Central Otago soils are free-draining and leach nutrients easily. Irrigation is needed most when water is scarce; if water is not budgeted correctly, it can result in low flows in summer and a degradation of water quality in downstream areas. If too much water is taken, this can lead to flows being insufficient to support aquatic life and being more sensitive to temperature changes. Most vulnerable are the smaller streams and rivers. Loss of water quality has both regional and national costs, through impacts on recreation and other amenity values, human health, and vulnerable ecosystems. This risk may be partly offset by more efficient methods of irrigation and other improved land management techniques. The move from older irrigation systems to more modern ones has the potential to improve water management, due to greater efficiencies of water use and less wastage.

	The economy The expansion of irrigation in the Central Otago region will allow the intensification and expansion of agriculture and horticulture in the region. This will enable growers and farmers to produce more goods, and goods of higher value, for both export and domestic markets. Intensified land use usually requires more workers, which could help to increase employment. These additional employees will spend money locally, boosting rural communities. The potential benefits of new irrigation schemes have to be balanced against the costs of establishing and running them. *Politics* Regional and central government must balance the needs of the growers and farmers of the regions with the needs of the environment, tourists, and urban communities. They must ensure that any expansion of irrigation is going to be environmentally sustainable – that the expansion isn't going to impede significant industries in the area, such as tourism and electricity generation. Water quality is also a major concern for the urban population, as seen in the 2017 general election, where water quality was an important issue for many voters.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24