Assessment Schedule – 2017

Agricultural and Horticultural Science: Analyse a New Zealand primary production environmental issue (91532)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
"Analyse" involves: • explaining the environmental issue arising from the primary production management practices • explaining potential courses of action to mitigate the negative impacts of the management practices • recommending sustainable production practices.	"Critically analyse" involves: • explaining, in detail, the environmental issue arising from primary production management practices • evaluating potential courses of action to mitigate the negative impacts of the production management practices • recommending sustainable production management practices that best address the issue.	"Comprehensively analyse" involves: • justifying course(s) of action to support sustainable production management practice(s) that best address the issue; this includes environmental, economic, political, and / or social considerations.

Note: For this schedule, the term "natural services" assumes the inclusion of services such as soil, water, and/or pollination, as described in the exam paper.

N1	N2	A3	A4	M5	M6	E7	E8
Attempts to describe examples of the decline in biodiversity or other relevant "natural services" such as soil, water, and / or pollination that agricultural and horticultural production systems in general may contribute to, but several errors are apparent in the description.	Describes examples of the decline in biodiversity or other relevant "natural services" such as soil, water, and / or pollination that a specified agricultural and horticultural production systems may contribute to, providing some accurate information. *OR*	Describes examples of the decline in biodiversity and / or other "natural services" that agricultural and horticultural production systems may contribute to. *AND*	Explains the decline in biodiversity and / or other "natural services" that agricultural and horticultural production systems may contribute to with reference to **either** economic **or** social factors. *AND*	Explains how ag / hort production systems impact on declining biodiversity and / or other "natural services", with reference to **both** economic **and** social factors. *AND* Provides examples of possible courses of action that could be implemented to mitigate the negative effects on biodiversity for agricultural or horticultural production systems. *OR*	Explains the contribution of a **specified** ag / hort production system's impact on declining biodiversity and / or other "natural services", with reference to **both** economic **and** social factors. *AND* Provides examples of possible courses of action that could be implemented to mitigate the negative effects on biodiversity for a **specified** agricultural or horticultural production system. *AND*	Explains the contribution of a **specified** ag / hort production system's impact on declining biodiversity and / or other "natural services", with reference to **both** natural-biological **and** social factors. *AND* Provides examples of possible courses of action that could be implemented to mitigate the negative effects on biodiversity for a **specified** agricultural or horticultural production system. *AND*	Explains the contribution of a **specified** ag / hort production system's impact on declining biodiversity and / or other "natural services", with reference to **both** natural-biological **and** social factors. *AND* Provides examples of possible courses of action that could be implemented to mitigate the negative effects on biodiversity for a **specified** agricultural or horticultural production system. *AND*

	Describes a course of action that a producer could use to mitigate the negative impacts on biodiversity.	Attempts to explain possible courses of action that could be implemented to mitigate the negative effects on biodiversity.	Provides examples of possible courses of action that could be implemented to mitigate the negative effects on biodiversity for agricultural or horticultural production systems.	Attempts to justify a recommended course of action, with consideration of ONE of the following: the social *OR* the natural-biological impacts of the recommendation.	Attempts to justify a recommended course of action, with consideration of ONE of the following: the social *OR* the natural-biological impacts of the recommendation.	Partially justifies the recommended course of action, with some consideration of BOTH the social and the natural-biological impacts of the recommendation.	Comprehensively justifies the recommended course of action with **detailed** consideration of BOTH the social and the natural-biological impacts of the recommendation.

N0 = No response; no relevant evidence.

Sample evidence

PART A

Natural-biological and social impacts

Biodiversity is the variability among living organisms, and the interwoven ecological whole of which they are a part, including diversity within species, between species, and of ecosystems.

- New Zealand's rural land supports a wide range of productive uses, including horticulture. Managing this productive land sustainably is crucial for this country's economic and environmental future. This productive land environment also plays a crucial role in New Zealand's culture and society.
- Prior to clearance for productive purposes, rural land supported a wide range of native species. Today, most native flora and fauna have disappeared and the majority of species found on productive land are introduced. Most native species have been marginalised to small pockets of native forest and wetland areas on private land.
- Although there has been significant progress in the battle against introduced weeds and animals on productive land, the increasing rise in the number of invasive alien species is still recognised as one of the major threats to biodiversity.

There are some poor land management practices, such as the increasing use of agrichemical inputs**.** Today, many farms are reliant upon the inputs of fertilisers, pesticides, and herbicides to run a successful operation.

- The effects of agricultural chemical use can be long-lasting. For example, the agrichemical DDT was used by New Zealand farmers during the 1950s and 1960s, primarily to kill grass grub and porina caterpillars. Although its use on farmland was prohibited in 1970, high levels of DDT accumulated in the country's soils during the years of heavy application. Many New Zealand soils still contain high levels of DDT.

The threat to biodiversity from the dependence on chemicals is an issue for New Zealand. The key issues arising from the use of toxic chemicals on productive land include:

- impacts on the hydrological cycle, as toxins run off into waterways and accumulate in the groundwater and marine environment
- pollution of the soil with the accumulation of heavy metals
- eradication of insects and beneficial pollinating species which are integral to productive land systems.

Other agricultural practices can also have a direct impact on biodiversity:

- Grazing stock can cause significant damage to remaining tracts of native vegetation. They browse on native plant species, disturb the ground and the native species living beneath the surface, and release large amounts of pollutants into the soil and waterways.

For example, dairying:

- Over the past two decades there have been major increases in dairy production in New Zealand. This increase in intensity has required increased use of external inputs, in particular fertiliser, feed, and water. Intensified dairy farming thus incurs considerable environmental externalities. These externalities are left for the wider New Zealand populace to deal with, both economically and environmentally.
- Significant costs arise from nitrate contamination of drinking water, nutrient pollution in lakes, soil compaction, and greenhouse gas emissions.
- The environmental consequences of dairying include pollution of surface and groundwater; destruction of wetlands and native lowland forests for farm development; indirect damage to freshwater and estuarine habitat through contamination and nutrient pollution of surface and groundwater; loss of native biodiversity through damage or destruction of native habitat; soil erosion, soil contamination, and damage to soil structure; and discharge of greenhouse gases.

<u>Social impacts</u>

- However, neither the exact nature of this threat nor the extent of its impact has received adequate reporting from a public perspective. A major problem for New Zealand society is how to weigh the economic benefits (and the lifestyle implications) of increased intensification of dairy production against the costs of environmental degradation. Environmental costs tend to be regionally localised, and many of the environmental costs remain subtle, complex, long-term, and hard to quantify.
- The Māori cultural belief system has links with the physical, natural, and spiritual realms, and includes natural resources such as food. The link with food includes concepts such as kaitiakitanga (guardianship or trusteeship, referring specifically to a way of managing the environment), mahinga kai (ability to access the resource for food gathering or a place where food is gathered), and tikanga (custom, method, plan, or practice).

<u>Water</u>

- The intensification and expansion of dairy farms have contributed many environmental problems, such as the contamination of ground and surface water, insufficient water for irrigation during droughts, and excessive loss of nutrients from farms.
- The significant increase in groundwater abstraction associated with land use intensification has contributed to a decline in groundwater levels, and reduced flows in rivers and lowland streams.
- Increased irrigation also means increased agricultural production and more intensive use of land. This increase comes primarily from increased groundwater takes. There has been a significant increase in irrigation in the last 20 years, a demand which is expected to continue in the near future. Use of water for irrigation can reduce river flows and ground water levels, and harm wetlands. Excessive extraction of water for dairy farming can lead to water shortages and to the destruction of aquatic ecosystems.
- A key water quality issue for dairy farmers is the significant amounts of excess nutrients, particularly nitrogen (N) and phosphorus (P) that leach into waterways.

<u>Greenhouse gases</u>

- Most recently, greater attention has been focused on some of the off-site impacts of farming activities, particularly the contribution of greenhouse gases such as methane and nitrous oxide to global warming.
- Larger emissions of greenhouse gases, particularly methane and nitrous oxide, from animal waste, and ongoing threats to biodiversity.

<u>Reduced habitats</u>

- Agricultural intensification is an ongoing threat to biodiversity, where structural complexity and diversity of indigenous vegetation and natural habitats have declined within New Zealand's agricultural landscapes over the past four decades.

- Recent measures of habitat extent and diversity have demonstrated the importance of habitat and landscape quality and quantity in determining bird abundance and community composition. Some pastoral landscapes contain only pasture, livestock, post and wire fences – but no trees or hedges.
- Land use conversion from sheep farming to dairy farming often leads to removal of shelter belts. For example, the area of shelter belts in the Te Pirita region of Canterbury reduced by 46% between 1984 and 2004 as a result of dairy conversions.

Overall

- One paper concluded that dairy farming intensification has led to severe degradation of several ecological systems. The main reason is that the price paid for dairy products does not reflect the external costs of depleting environmental resources or causing environmental degradation.
- Water quality and quantity are considered the most important attributes, and are highly valued by farmers.

PART B

Explain what a producer of your selected product could do to protect and / or improve the biodiversity of the local environment by changing on-farm management practices.

Many people are already participating in a variety of biodiversity projects. Wetlands are being restored, and possums and other pests are being controlled.

Value of biodiversity to productive land

New Zealand's land-based primary production – including horticulture – is reliant on the protection and management of biological systems. The variety of species found on productive land (both native and introduced) have many direct and indirect commercial production benefits, including:

- pollination of crops
- biological control of pests, weeds, and diseases
- improvement of soil formation and its microbial activity
- increased nutrient retention
- improved air and water quality
- erosion prevention
- capture of carbon dioxide by plants, and of carbon by soil.

Functional agricultural biodiversity

In addition, retaining biodiversity on productive land may assist in marketing goods to the green consumer market and supporting on-farm tourist activities. Therefore, when biodiversity is lost from farmland, it is not just the loss of species of conservation value that is occurring, but also the loss of organisms that can provide substantial commercial benefits. This type of biodiversity is often called 'functional agricultural biodiversity', and its functions, increasingly referred to as 'ecosystem services', can be wide-ranging and of much value to landowners. Much of the production in agriculture depends on these ecosystem functions and processes.

Ways to mitigate

- Landowners are voluntarily investing time, effort, and money into projects which have wonderful biodiversity benefits, including the fencing of stock from streams and protecting forest remnants. Rural landowners are planting riverbanks.
- Biodiversity benefits on farms can be seen in retired forest blocks and pest control, and in the planting of trees and shrubs for erosion control, riparian protection, and for aesthetic reasons. Although these plantings may not always be indigenous, they provide important habitats for indigenous species.
- There is an increased awareness and recognition amongst landowners of the importance and benefits of biodiversity – to them and their business. Many rural landowners already participate in biodiversity enhancement projects, such the establishment of covenants on their properties.

- Recognising the risks arising from wetland loss, agencies, conservation groups, and landowners have worked hard to protect and restore the wetlands which remain. Management has focused on restoring hydrological processes (water levels and flows), weed and animal pest control, fencing, planting, and at some sites, provision of recreation and education facilities.
- Agroecological methods such as conservation biological control can increase the ecosystem services value of agriculture while reducing negative impacts from the use of pesticides, fertilisers, and fuel.

Example of mitigation – grapes

- Vineyards are typically monocultures, with a low provision of ecosystem services.
- A New Zealand government-funded initiative is aiming to combat this problem. A key example of habitat modification in the vineyard ecosystem is a study in which buckwheat, phacelia, and alyssum were planted to provide nectar resources for key parasitoid wasps, which subsequently increased sufficiently to reduce the number of pests below the economic threshold.
- In addition to pest control, other ecosystem services were enhanced; for example, New Zealand endemic plants were used as mulch to disrupt the life cycle of grey mould, or to suppress weeds.
- Beetle banks are strips of farmland set aside to provide a habitat for wild animals in the hope that some will keep down the numbers of crop pests. The strips can border agricultural land or run through the middle of large fields, and are typically planted with a variety of plant species, including grasses, flowers, and herbs.
- Although the primary function of a beetle bank is pest control, they are also habitats for other beneficial flora and fauna that may provide additional services, such as pollinating crops. Bumble bees, butterflies, and other nectar feeders may colonise the beetle bank and extend their foraging range to include the crop, while tall plants growing in beetle banks can catch airborne weed seeds that might otherwise drift onto farmland.

PART C

<u>Collaborative partnerships</u>

Farmers depend on the production of crops, protein, and fibre for their livelihood, and if ecosystem services on their farmlands are to be fostered, clear protocols must be developed. A good example of these is the concept of a service-providing unit (SPU).

- An SPU is a protocol that clearly indicates the characteristics of biodiversity required to deliver a given ecosystem service at the level needed by those who stand to benefit from the service.
- In New Zealand, examples of SPUs include “beetle banks” and the previously mentioned use of buckwheat as an additional nectar resource for natural enemies, to enhance conservation biocontrol in vineyards.
- Significant progress will require a focus on the common ground shared by those with a stake in the wise management of ecosystem services, and any disagreements must be resolved by open dialogue between policymakers, scientists, and practitioners.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 2	3 – 4	5 – 6	7 – 8