



Year 12
Agricultural and Horticultural
Science
Environmental Impacts

Name: _____

AS 91298 Report on the environmental impact of the production of a locally produced primary product

Level 2

Credits 4

Assessment Internal

| Achievement | Achievement with Merit | Achievement with Excellence |
|--|--|--|
| <ul style="list-style-type: none">• Report on the environmental impact of the production of a locally produced primary product | <ul style="list-style-type: none">• Report effectively on the environmental impact of the production of a locally produced primary product | <ul style="list-style-type: none">• Report comprehensively on the environmental impact of the production of a locally produced primary product |

Report on the environmental impact *requires*: an explanation of how production a locally produced primary product impacts on the environment.

Report effectively on the environmental impact *requires*: a considered explanation of how production a locally produced primary product impacts on the environment.

Report comprehensively on the environmental impact *requires*: a concise, coherent and accurate summary that evaluates the overall impact of the production a locally produced primary product impacts on the environmen

| Achievement | Merit | Excellence |
|--|---|--|
| <ul style="list-style-type: none"> Report on the environmental impact of the production of a locally produced primary product | <ul style="list-style-type: none"> Report effectively on the environmental impact of the production of a locally produced primary product | <ul style="list-style-type: none"> Report comprehensively on the environmental impact of the production of a locally produced primary product |
| <p>This Requires: an explanation of how production a locally produced primary product impacts on the environment.</p> <p>The report covers all aspects of the environment</p> <ul style="list-style-type: none"> Soil water Air Organisms <p>You need to:- Correctly identify the significant environmental impacts that are a results of farming operations carried out during the production of a primary product</p> <p>and</p> <p>Explain how the production process causes these impacts on the environment</p> | <p>This Requires: a considered explanation of how production a locally produced primary product impacts on the environment.</p> <p>The report covers all aspects of the environment</p> <ul style="list-style-type: none"> Soil water Air Organisms <p>You need to:- Correctly identify the significant environmental impacts that are a results of farming operations carried out during the production of a primary product</p> <p>and</p> <p>Explain in detail using a range of resources and information how the production process causes these impacts on the environment</p> | <p>This Requires: a concise, coherent and accurate summary that evaluates the overall impact of the production a locally produced primary product impacts on the environment</p> <p>The report is concise and accurate</p> <p>It discusses</p> <ul style="list-style-type: none"> the overall impact on the environment that the production of the primary product causes. provides a balance viewpoint on positives and negative impacts of the production process. <p>Include</p> <ul style="list-style-type: none"> why the management practices is important to crop yield and quality modifications to management practices growers are using to minimize the environmental impact in order to produce a sustainable profitable crop. |

Aim: Report on the environmental impact of the production of a locally produced primary product

Specific objectives

A Knowledge

At the end of the unit students should be able to:

- 1 Explain how production of a locally produced primary product impacts on the environment
 - 1.1 describe the significant management practices carried out to grow a locally produced primary product
 - 1.2 explain why these management practices are carried out to produce a high yielding quality primary product
 - 1.3 identify key management practices carried out during the production process of the locally produced primary product that could affect/impact the environment.

Cultivation, agrichemicals (fertilisers, spray), irrigation,
 - 1.4 Explain how selected management practices carried out in the production of a primary product could affect/impact the environment.

Soil water and air quality or organisms
- 2 Discuss actions/management practices/possible modifications to the production process that will reduce or minimise the identified environmental impacts
 - 2.1 Describe modifications to management practices grower used that will reduce or minimise the identified environmental impacts
 - 2.2 Explain the strengths(positives) and weakness(negatives) of each action/ management practice/modification that could be to used minimise or reduce the negative effect on the identified environmental impacts.

Impact of Primary production on the Environment

The production of agricultural and horticultural crops in New Zealand often impact on the local environment. This includes soil stability/structure, water and air quality and beneficial organisms. Over time, this may cause a decline in the level of production. It could also affect ecosystems and communities, causing problems for growers selling New Zealand products in overseas markets.

This topic on environmental impact of selected management practices used in the production of primary products requires you to visit a local grower and report on the environmental impact of their production.

The aim of all primary producers is to grow a high yielding quality crop economically and sustainably.

Exercise

- 1 *List the requirements for growing a high yielding quality crop and explain how they affect yield or crop quality.*
- 2 *Describe how a grower would provide these growing conditions*
- 3 *Draw a flow diagram of the management practices a grower would use to grow a high yielding quality outdoor vegetable crop.*

Reasons why environmental issues are a concern

NZ clean green image

Marketing of NZ primary products

Greenhouse gases

Tourism

Sport and recreation

Water related health issues

World demand for food safe and sustainably produced products

The key management practices which can have an environment impact on soil, water, air and organisms include

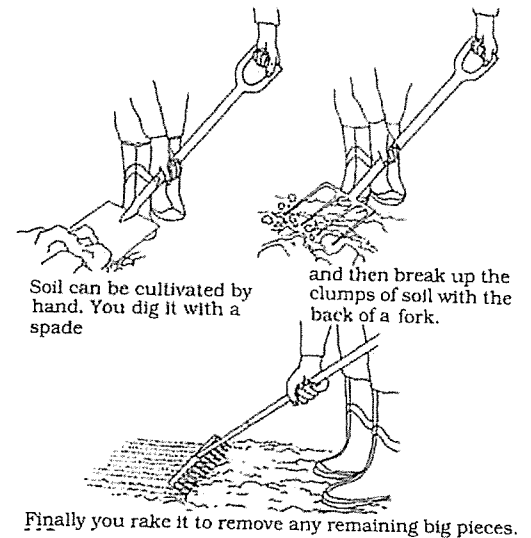
- Cultivation
- Use of agrichemicals
- Irrigation

CULTIVATION

Good cultivation techniques breaks the soil structure into smaller pieces making a well structure seedbed with a good mixture of macro and micropores allowing for good drainage, aeration and root movement. The aim of cultivation is to provide a more suitable environment for seed germination and plant growth. Good cultivation provides a good seedbed free of weeds for plant growth. It allows good root movement through the soil to absorb water and nutrients. Fertilizer can be added during cultivation

Reasons for cultivating soil include

- It is easier to plant plants and sow seeds in loose soil.
- The soil is fine enough for ease of root movement and allows roots to have good contact with the soil to absorb water and nutrients.
- Fertiliser can be mixed into the soil.
- It gets rid of weeds or other existing vegetation.
- It can improve aeration and drainage.



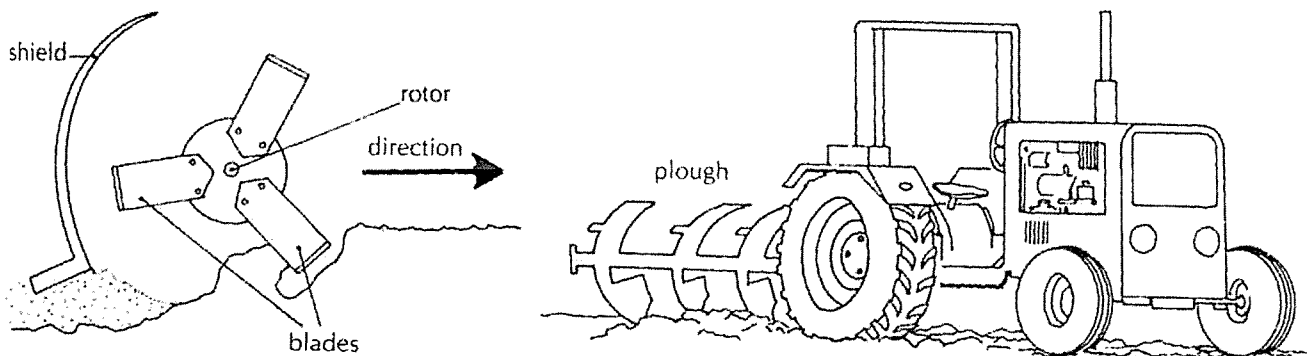
Exercise

Explain how cultivation improves crop production.

Methods of commercial cultivation

There are many techniques used to cultivate soil. They are often used in combination with each other to provide a suitable seedbed. These include

- Rotary hoe
- Power harrows
- Plough
- Discs
- Tine harrows
- Minimum tillage



Exercise

- 1 For each of the above methods of cultivation draw a table to state their advantages and disadvantages.
- 2 Compare the effects on soil properties of nil tillage and over cultivation, and explain how these effects influence plant growth.

Environmental impact of cultivation

- Under continuous intensive cultivation soil structure breaks down resulting in poor aggregate stability.
- Use of cultivation equipment such as rotary hoe and power harrow causes the soil structure to breakdown especially when soil conditions are too wet or too dry
- This leads to soil compaction decreasing aeration and drainage. This affects crop yield and increases the risk of wind and water erosion
- Under continuous intensive cultivation soil structure breaks down resulting in poor aggregate stability. This leads to an increase risk of soil erosion by water and wind and the subsequent loss of valuable topsoil. This topsoil contains fertiliser and agrichemicals which further decrease water quality
- Water erosion of cropped land results in sedimentation and nutrient contamination (nitrogen and phosphates) of water ways, reducing water quality. This reduction in water quality (eutrophication) can change and damage the waterway ecosystem which could result in the loss of plant/ fish and animal life in the waterway. This results from
 - Sediment may alter the colour or temperature of a waterway this can upset /kill aquatic life
 - Sediment will smother water plants and may reduce light infiltration negatively affecting plant photosynthesis
 - Increase in weed growth as a result of increased levels of nitrogen and phosphorus in the water. These can decrease oxygen availability which will upset the aquatic ecosystem
 - Cause algal blooms reducing oxygen levels in water. The algal bloom can block light levels for other organisms such as fish causing them to die.
- Wind erosion as a result of the breakdown of soil structure to fine particles can reduce air quality especially in dry conditions.
- Greater production of greenhouse gas emissions. This is for the use of fossil fuels operating equipment throughout the production process from crop establishment to harvesting. Greenhouse

gases such as carbon dioxide lead to increase air temperatures and plant growth but are contributing to rising sea levels and extreme weather events

- The breakdown of soil structure and subsequent loss of organic matter reduces soil organism levels. These decrease the health of the soil and can result decreased crop yields

Exercise

Summarise the environmental impact of cultivation under the following headings.

| Environmental impact of cultivation | | | |
|-------------------------------------|-------|-----|-----------|
| Soil | Water | Air | Organisms |
| | | | |

Modification of Management Practices to reduce environmental impact

Management practices growers can use to minimise/reduce the environmental impact of cultivation include:

Site selection

Select sites that have soils suitable for cultivation and at an appropriate stage in the crop rotation.

Crop rotations

Good crop rotation practices improve soil structure by using green manure and cover crop. These crops return organic matter to the soil, can absorb surplus nutrients particularly N, increase N levels through nitrogen fixation if a legume crop is used. High organic matter levels help build structure and maintain high micro and macro soil organism levels which are key to a healthy productive soil. A good crop rotation

- will break pest and disease cycles which reduces the need for agrichemicals to control them
- reduce applications of nitrogen fertilisers
- reduce nitrogen leaching and soil erosion by growing cover crops

Select and use equipment that minimise structural damage

When possible use low impact equipment such as a plough and tine harrows rather than high impact equipment such as a rotary hoe and power harrows.

Use low pressure dual wheels wide tyres or track wheels to reduce soil compaction

Timing of management practices

Timing is essential for good seedbed preparation and to maintain good soil structure. Cultivate only when soil conditions are suitable not too wet or too dry. Cultivation at the right moisture content maximises

the breakdown of the clods, helps preserve soil structure and allows seedbed preparation with the minimum number of passes. This reduces fuel and labour costs therefore the cost of production.

Avoid driving over crops under wet conditions (side dressing, spraying, harvesting)

Manage traffic to avoid soil compaction

Minimising and managing trafficking can reduce soil compaction. This can be achieved by:-

- reducing the number of vehicle passes (combine tillage implement in tandem and use wide implements
- using tram lines and wide wheel based machinery

Exercise

Evaluate the key modification to cultivation management practices a vegetable grower would use to minimise the effect the environmental effects of cultivation. In your answer consider the

- *positives of cultivation on crop production*
- *the changes the modifications to cultivation management practices have on reducing the environmental impact soil, water, air and organisms*

Agrichemicals

During the last few decades primary producers has made increasing use of agrichemicals . By using agrichemicals, growers are able to produce high-quality produce that meet export specification and access high-value markets

Agrichemicals include;

- Herbicides
- Fungicides
- Pesticides
- Bactericides
- Fertilisers

Chemical control, be it by natural or synthetic chemicals, provides the most rapid and effective means of pest control. Provided you apply the chemicals correctly, you can easily approach total control of the pests; but remember that while you can achieve a rapid curative effect, the use of any chemical can disrupt controls against other insects. Ideally you should use “selective” insecticides – those that kill the pest but not natural enemies or bees – rather than “broad-spectrum” insecticides which act as general biocides killing pests and beneficial insects. Incorrect use of insecticides can lead to outbreaks of insects that were previously controlled by natural enemies. You will then need to use more chemicals to control those pests, and thus you will find yourself on the “pesticide treadmill”.

The use of artificial fertilisers has significantly increased over the last few decades particularly nitrogen and phosphate based fertilisers. They have been used to increase production and produce quality products required by consumers both domestically and internationally. Application of fertilisers improves nutrient availability for plant production. They are used to replace lost or deficient nutrients need for crop growth. Many crops such as potatoes and onions require large quantities of macro nutrients(NPK) to produce high yielding quality crop. However, indiscriminate use of fertilisers and high application rates can have a significant environmental impact through:-

- nutrients be leached into underground aquifers
- topsoil eroded by wind and water into waterway

Exercise

Explain how the use of agrichemicals improves crop production.

Environmental impacts of agrichemicals

- Water pollution, due to leaching of chemicals into waterways or underground aquifers. The leaching of chemicals into waterways and aquifers is a particular risk for agricultural fertilisers and sprays. These have the greatest potential to be applied in quantities that risk leaching – causing increased nutrient levels in the water, accelerated growth of algae, and loss of habitat for living organisms. The run-off from foliage of chemical sprays over time can also end up in waterways.
- Residual build-up of toxic chemicals in the soil over time. Many chemicals applied to land and crops do not break down in the soil. Over time, their concentration in the soil builds up to levels that may be toxic to plants and animals. Another danger is the chemicals re-entering the food chain and negatively impacting on plant and / or animal life.
- Harming of non-target species through the use of non-selective / broad spectrum pesticides / insecticides (eg honey bees).
- Air pollution caused by spray drift (eg, copper-based chemicals). Many agrichemicals are very toxic and many people suffer adverse reactions (especially asthmatics) if they come into contact with the chemical via spray drift or by some other means.

Exercise

- Summarise the environmental impact of agrichemicals under the following headings.

| Environmental impact of agrichemicals | | | |
|---------------------------------------|-------|-----|-----------|
| Soil | Water | Air | Organisms |
| | | | |

Modification of Management Practices to reduce environmental Impact

There are a number of management practices growers can implement to minimise the environmental impact of using agrichemicals.

Time agrichemical applications carefully. For example:-

- Minimise spray drift by only spraying when there is no wind
- Minimise leaching by applying the small quantities of fertiliser based on soil tests and soil type
- Do not spray flowering plants unless the chemical is recognised as being non-toxic to bees or spray early in the morning when insect activity is low.
- Apply pesticides only when necessary, ie once you have seen the pest or its damage.

Use a “selective” chemical where possible.

Use pest monitoring techniques

Pest monitoring is a guide insecticide spraying; it involves a reduced choice of pesticides with use at long, pre-harvest intervals; greater use of “soft” pesticides [mineral oil, *Bacillus thuringiensis* (Bt) sprays]; and modified plant / canopy / soil management to reduce disease pressure and hence the need for frequent, high-volume spraying. All these contribute to reducing the environmental impact of agrichemical use.

Use IPM-type programmes

Integrated control refers to the harmonious blend of chemical and biological control by the use of such means as pest monitoring, selective insecticides, reduced dosage and limited application.

Using IPM-type programmes to manage pests / diseases / weeds within primary production systems reduces volumes / frequencies of chemical / spray / therefore lower cost and environmental impact.

However IMP programmes;

- Require more time spent monitoring pest and disease numbers within the growing system.
- Some crops / industries do not have suitable chemicals either available or “registered / approved for use”.
- This can be considered a high-risk approach – if you get it wrong, the season’s crop is potentially ruined.

Exercise

Evaluate the key modification to the use of agrichemical a vegetable grower would use to minimise their effect environmental impacts. In your answer consider the

- *positives of using agrichemicals in crop production*
- *the changes the modifications to agrichemical use have had on reducing the environmental impact on soil, water, air and organisms*

Irrigation

Water is being continually lost from the soil. If rainfall is insufficient some form of irrigation is needed. The purpose of irrigation is to supplement the natural rainfall during periods of shortage. There are **three** reasons why periods of soil moisture shortage occur?

- when the total rainfall is low
- when the total rainfall is unevenly distributed.
- the soils are shallow and with a low water holding capacity.

The positive benefits of irrigation

The benefits of irrigation are increased crop productivity and profit through greater crop growth, higher yields, and improved product quality. Irrigation increases water availability for crop production. This increases the rate of photosynthesis and ability of plants to absorb nutrients.

Commercial methods of irrigation include;

- Big gun
- Center pivot
- Trickle irrigation



Exercise

- 1 Explain how irrigation improves crop production.
- 2 For each of the above methods of irrigation draw a table to state their advantages and disadvantages.

Environmental impact of irrigation

Decreased river and stream levels

As water is extracted from streams and rivers for irrigation purposes, the volume of water remaining in the watercourse is reduced. The water applied to the land does not re-enter the rivers and streams, as it is used for crop growth and evapo-transpiration.

Increased water temperatures

Lower river volumes result in the water heating up faster. Warmer water contains less dissolved oxygen, and so aquatic life is adversely affected. Growth of weeds is also enhanced with warmer water temperatures.

Less dilution of contaminants, eg agrichemicals and effluent

As the volume of water does not generally diminish as river levels drop, the dilution of any contaminants entering the river is decreased, potentially pushing the level from previously acceptable to unsafe / unacceptable levels which can harm or kill plant and fish life.

Greater potential for leaching of soil nutrients

The introduction of irrigation to the growing system is matched by an intensification of land use, fertiliser application, etc, carrying with it a greater potential for nutrient leaching. If the land users over-irrigate (apply water to excess of field capacity), the excess water drains away via leaching or surface run-off. Run-off carries with it dissolved nutrients and possibly effluent.

Lowering of water tables and aquifers

As water is extracted from underground aquifers, the extraction may exceed the rate at which water enters the aquifer. This results in the level of the aquifer dropping, which in turn can reduce in-stream flow rates and dilution rates, and has potentially been linked to land instability / subsidence.

Exercise

- Summarise the environmental impact of irrigation under the following headings.

| Environmental impact of agrichemicals | | | |
|---------------------------------------|-------|-----|-----------|
| Soil | Water | Air | Organisms |
| | | | |

Modification of Management Practices to reduce environmental Impact

Restrict water usage to a level where minimum flow levels (that have been established according to acceptable environmental impact by regional councils) are not reached.

The strengths of this would be:-

- Current usage, practices and economic benefits are essentially allowed to continue.
- The environmental impacts are kept to a minimum – river habitats are essentially sustainable.

However negatives of restricting water use are

- Potential production and income is not realised, due to the inability to further develop / irrigate areas that are already fully allocated in terms of their allowable water usage.
- Times when the water is needed the most, ie during droughts, are when river and stream flows are at their lowest, and there is little or no water available.
- Debate exists as to what the minimum flows should be; the maximum extraction rates that aquifers can cope with are still being established.

Develop strategies to better utilise the water currently available, eg store the excess water in times of plenty, using irrigation storage dams.

The strengths of this would be:-

- Production and revenue are further increased by being able to access water at times when the minimum flow restrictions previously prevented it.
- Environmental impacts on river ecosystems and aquifer levels are kept at current levels.

However negatives of strategies to better utilise water are:-

- Storage dams have their own environmental impacts.
- The cost of building these are high, often require local or central government assistance, and have to cope / comply with the Resource Management Act and other “red tape”.

Restrict the “take” of water for irrigation to a point where the impact on river and stream levels are negligible and water tables are unaffected.

The strengths of this would be:-

- River ecosystems can be allowed to return to previous states.
- Our “clean, green” image with overseas markets and tourists is enhanced.
- Water for stock, household, and other purposes remains available.

However negatives of restricting the take of water for irrigation are:-

- Collectively, growers have invested hundreds of millions of dollars in irrigation systems, and rely on them for the economic viability of growing their primary products. They will be severely affected, and in many cases their farms systems will become uneconomic.
- Some dry regions would risk reverting to wind erosion-prone, weed infestation prone landscapes and land uses.
- Irrigation is a large contributor to the “green” appearance that New Zealand is famous for. Less of it means more dry, arid images for both local and overseas observers.

Exercise

Evaluate the key modification to irrigating a crop a vegetable grower would use to minimise their effect environmental impacts. In your answer consider the

- *positives of irrigation on crop production.*
- *the changes the modifications to using irrigation systems would have had on reducing the environmental impact on soil, water, air and organisms*

Exercise

Summarise the environmental impact of all key management practices under the following headings. To do this Describe the management practices that effect of soil water, air and organisms and explain how they impact on them

| Environmental impact of agrichemicals | | | |
|--|--------------|------------|------------------|
| Soil | Water | Air | Organisms |
| | | | |