Fertilisers and The Environment

Where do plant nutrients come from?

Decaying plant litter

Breakdown of soil minerals

Addition by humans: commercial fertiliser, lime, manure

Ways to improve soil fertility

- Aerate the soil through drainage
- Apply lime if pH is low
- Plough in green manure to give food to bacteria and worms
- Apply commercial fertilizers according to crop requirements
- Apply the method of crop rotation

Fertilizers

- A fertilizer or manure are materials that contain one or more of the essential elements and are applied to soils to encourage crop growth.
- The amount added is decided on after soil analysis.
- Fertilizers are mainly **inorganic** and are manufactured materials.
- Manures are **organic** (made from plant and animal wastes).

- Most of the fertilizers sold in Ireland contain N, P and K either singly or in a combination.

- Fertilizers are manufactured from the following:
  - Atmospheric N, Ammonia or Nitric Acid
  - Mineral rock phosphates (North Africa)
  - Natural potassium salts (potash) imported from Eastern Europe.

- Fertilizers containing one nutrient element are called **straight fertilizers** and those with a combination are **compound fertilizers**.

Straight Fertilizers

CAN

- The most important straight fertilizers in Ireland are **Calcium Ammonium Nitrate**.
- Calcium ammonium nitrate is the largest selling fertilizer in Ireland.
- Nitrogen occurs in a nitrate form and ammonium form.


Calcium Ammonium Nitrate
Field Grade Add Boron
Nitrogen : 15.5 % min CaO : 26.0% min
MADE IN CHINA
N.W. : 25 KG G.W. : 25.1 KG
LOT NO. :

- The acidifying property of ammonium ions (NH4+) is buffered reduced by the Ca (CA+2) in CAN and is therefore very useful as a source of N.

- Crops grow best at a ph of between 5.5 and 6.5

- The calcium stops the soil's ph from becoming too acidic

- Another advantage is that CAN is a fast acting fertiliser
- CAN must be spread as soon as it is exposed to air, as wastage and caking will occur otherwise.
- It becomes hardened and cannot be spread
- CAN is said to be hygroscopic, it absorbs moisture from the atmosphere.

Urea

- The use of Urea is increasing due to the high levels of N in its compound (46%). This means the farmer can spread less fertiliser.
- It doesn't give a higher crop response than CAN, however, because it takes longer to change to Nitrate form.
- Urea must first be converted to ammonium and then to nitrate which takes quite a long time


UREA
MICRO GRANULE

- On sunny dry days, urea can decompose and can be wasted to the atmosphere. This is called volatilisation. The ammonium ions are converted to ammonia gas and lost to the atmosphere in dry and sunny weather

- It is therefore recommended that urea is only spread before May 1st, after August 15th or when rain is forecast.

Ground Rock Phosphate

- Ground rock phosphate is used as a straight fertilizer mainly for the forestry industry
- These soils are nearly all acidic and the P is released slowly to the trees.
- In normal soils, GRP is of little use.

Compound Fertilizers

Compound Fertilisers

- Compound fertilizers are made from mixing straight fertilizers or by chemical synthesis of other raw materials.
- In chemically synthesised fertilizers, P is more available than in GRP.
- Compound fertilizers are named by listing their percentage content of N, P and K.
- For example 10:10:20 contain 10% N, 10% P and 20% K.


Grassland
10-10-20
Grassland
10-10-20

Compound Fertilisers

- The remaining percentage is made up of chemicals and impurities of various kinds.
- The nutrients are balanced as to reflect the uptake of the particular crop.

Fertilizers
18 : 6 : 12
27 : 2.5 : 5
0 : 7 : 30
0 : 10 : 20
10 : 10 : 20
24 : 2.5 : 10

Compound Fertilisers

- 18 : 6 : 12 is designed for silage and hay crops, grassland and cereals
- 27 : 2.5 : 5 is used on heavily stocked grassland, cereal crops
- 0 : 7 : 30 is used for autumn spreading on land set aside for silage.
- 24 : 2.5 : 10 is used on grassland
- 7 : 6 : 17 is used on root crops

Sulphur Deficiency

- Sulphur deficiency can occur easily in sandy soils under intensive crop production.
- To overcome this problem sulphur is added to both straight and compound fertilisers
- It is said to be a trace element, needed in small amounts.

Macro v Micro Elements

- A Macro Element is needed in large amounts eg Nitrogen

- A Micro Element is needed in small amounts eg Sulphur (Also known as a trace element)

Common Nitrogen Fertilizers

Calcium Ammonium Nitrate (CAN)

- Approx 25% nitrogen
- Approx 20% lime

Urea

- Approx 46% nitrogen

Sulphate of ammonia

- Approx 21% nitrogen

Common Phosphorus Fertilizers

Superphosphates

- 8-16% phosphorous
- Contains 12% sulphur

Soft ground rock Phosphate

- Approx 11% phosphorous

Basic slag

- Approx 6-7% phosphorous
- Contains lime

Common Potassium Fertilizers

Muriate of potash

- Contains 50% potassium
- By- product of salt mining industry

Sulphate of potash

- Contains 42% potassium
- Used mainly on potatoes and crops sensitive to chlorine

Exam Q

- Suggest **two** reasons why a farmer might use sulphate of ammonia rather than other forms of artificial nitrogenous fertilisers.

- Not as high in N as urea or CAN
- won't burn grass
- wont cake
- Cheaper
- has acidic reaction
- will lower pH in alkaline soil
- helps with S deficiency
- makes protein in plant
- non-volatile
- slower than CAN
- faster than urea

Fertiliser Applications

- Fertilizers can be applied in three ways:

Direct Drilling

Drilled into the soil along with seeds using a seed drill

Broadcasting

They can be broadcast with a fertilizer spreader (with reciprocating arm) and mixed during cultivation processes.

Top Dressing

They can be broadcast onto a growing crop. This is called **top dressing**.

Manures - Organic

- Both animal slurry and farmyard manure have similar low concentrations of minerals.

- The average composition is:
  - 0.5 % Nitrogen
  - 0.15 % Phosphorous
  - 0.60 % Potassium

Manures

- Manures are waste materials of plants and animals.
- It is spread onto soils as it gets rid of waste on the farm
- It also adds organic matter to the soil and improves soil structure
- There are five main sources of manure:
  - Farmyard Manure
  - Animal slurry
  - Straw
  - Seaweed
  - Sewage sludge

FYM – Farmyard Manure

- Farmyard manure is a mixture of faeces, urine and bedding, and is a by product of winter housing of animals. It rots over time and is added to the soil. As it rots it releases nutrients into the soil. It adds organic matter and improves soil structure
- It is high in organic matter and is beneficial to the soil.

Slurry

- Causes a quicker response to crop growth because its absorbed really quickly.
- The spread of pests and diseases should be considered when spreading.
- It should be kept to grassland but it encourage weeds especially docks.
- Slurry does not add as much organic matter as manure because it does not have straw.
- It also does not improve soil structure

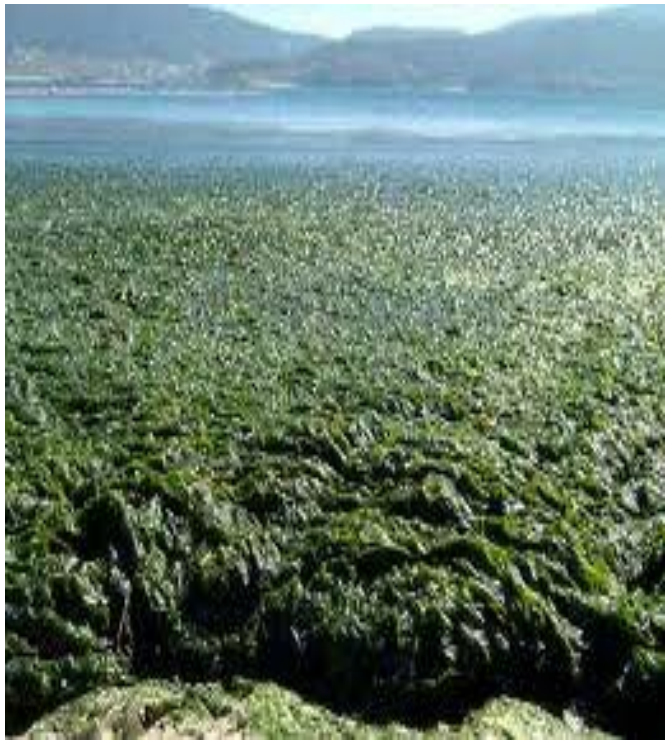
Slurry

FYM

Straw

- Straw can be incorporated back into the soil
- The Straw adds nutrients to the soil
- It depends on the price of straw that year

Seaweed



- Seaweed is known as green manure
- Useful if living beside the coast

Manure Application

- Farmyard manures are spread using a **muck spreader**.
- The spreader is filled using a tractor and a front loader.
- It is then torn up and spread from the side of the spreader.


PLATTS

Manure Application

- Slurry spreaders suck slurry into the tank using a tractor driven pump.
- When being applied the pump is reversed and the material is pumped out.
- It hits a deflector plate, which spreads the slurry in a band of about 6m wide.

Granular form

- Straight and compound fertilisers are all sold in granular form.

- This improves fertilizing in two ways:
  - Reduces caking
  - More accurate spreading

Soil Index

- A soil test should be carried out every 2 to 3 years
- An Teagasc categories soils in a soil index system
- This ranks a soil by it's fertility level and its likely response to fertiliser application
- The level of nutrients required to grow a crop and the ph of the soil are also taken into account

Soil Index

- If the soil ph is too low, liming may be recommended
- The soil analysis will tell you what nutrients in a soil and what type and how much fertilisers to apply

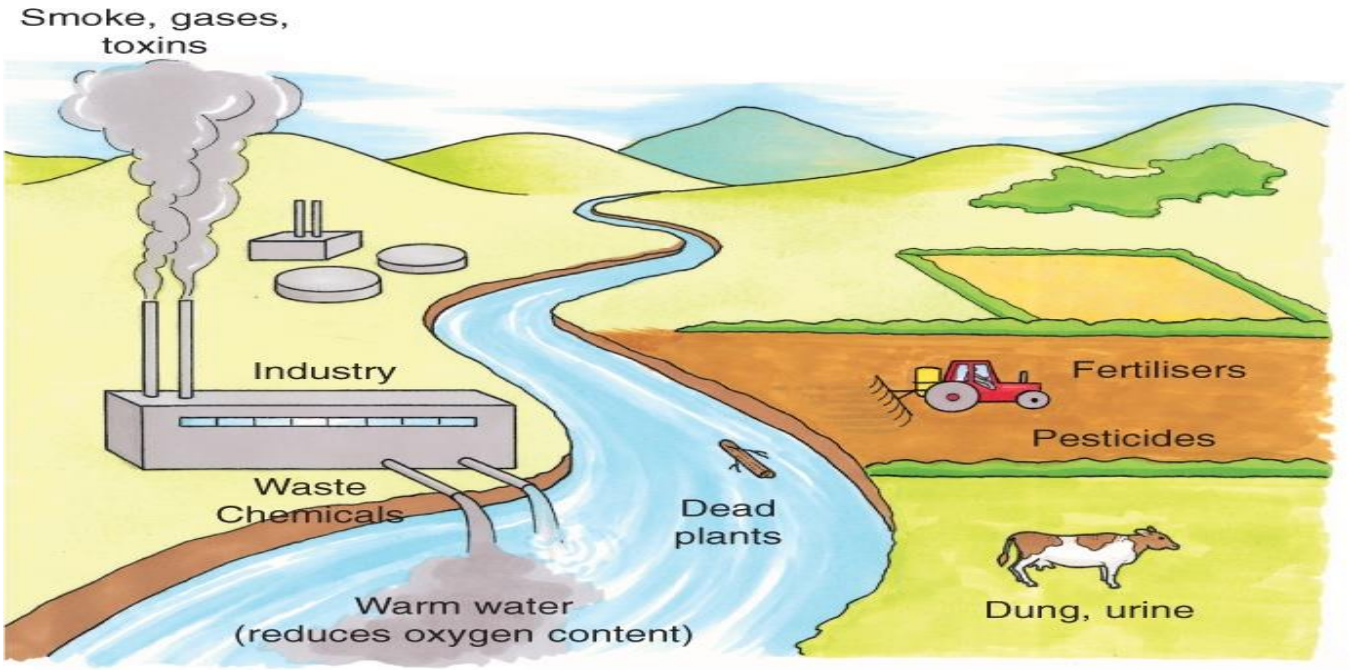
Soil Index

Soil Index Value	Index Description	Response to fertiliser
1	Very low	Definite
2	Low	Likely
3	Medium	unlikely
4	Sufficient/Excess	None

Pollution

- Fertilizers, Slurry and Manure are some of the many pollutants found on a farm.
- When organic matter enters a river (slurry, silage, milk, fertilizers, etc), aerobic bacteria and other organisms try to break it down and get rid of it
- However when breaking down the organic matter a lot of dissolved oxygen in the water is used up.

Pollution


Smoke, gases, toxins
Industry
Waste Chemicals
Warm water (reduces oxygen content)
Dead plants
Fertilisers
Pesticides
Dung, urine

BOD Biological Oxygen Demand

- Every pollutant has a BOD value. It tells us the amount of oxygen a pollutant needs for it to be broken down in 1L of water.
- The higher the BOD value of a pollutant, the more oxygen it uses up in a river and the more fish it kills
- Clean water has a BOD value of 1-2
- Polluted water has a BOD value of 100

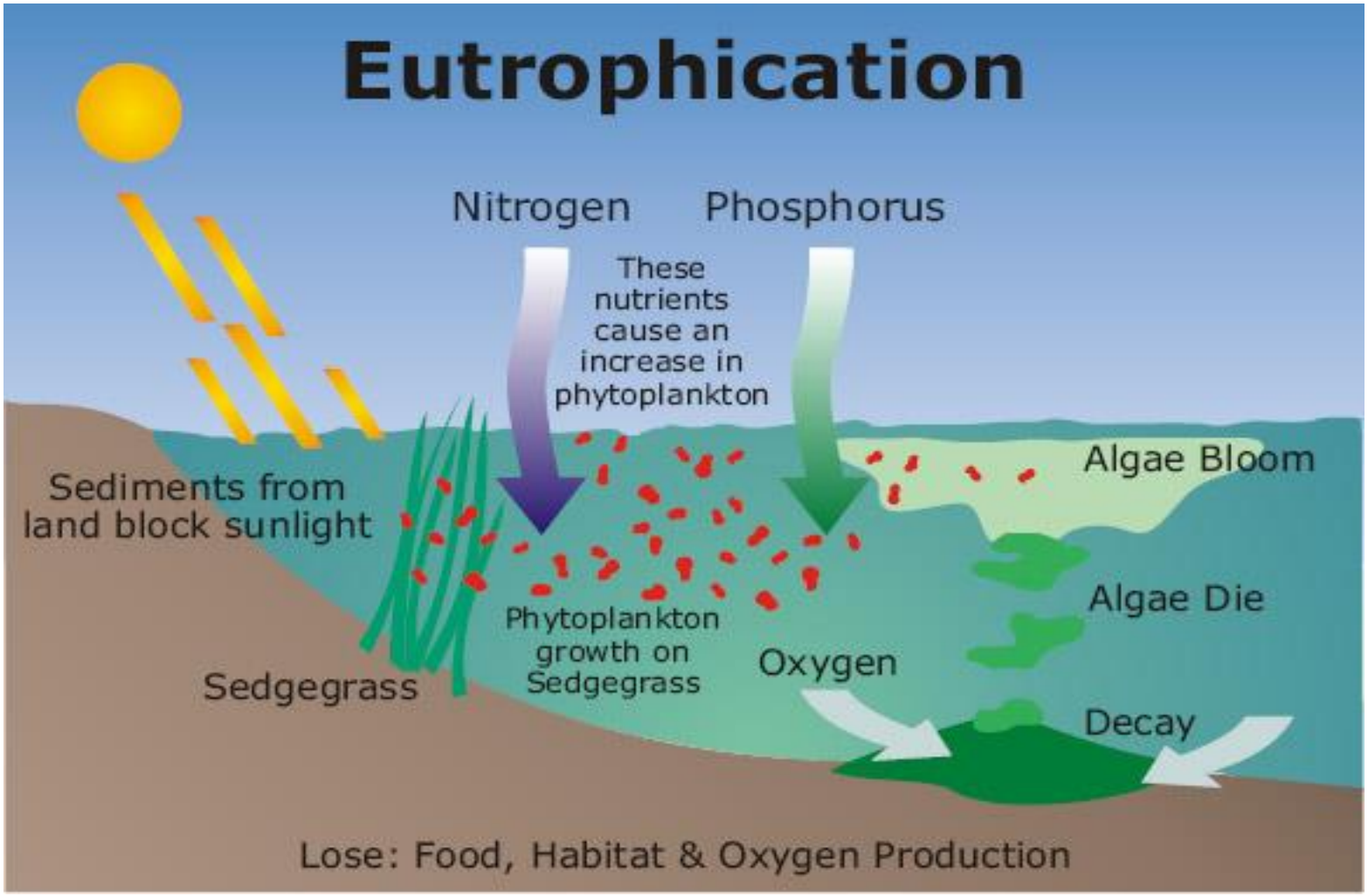
Examples of pollutants and their BOD values:

- Domestic sewage 300 BOD mg/l
- Cattle slurry 17,000 BOD mg/l
- Pig slurry 25,000 BOD mg/l
- Silage effluent 65,000 BOD mg/l
- Dairy washings 2,000 BOD mg/l
- Whole milk 100,000 BOD mg/l

Eutrophication

- Eutrophication is caused when run-off from fertilizers (which are very rich in nutrients) enters a river.
- The nutrients cause a surge in growth of plant life in the river.
- Over time the river can turn green with the excessive growth of plant life, Sometimes an Algal Bloom forms .
- The problem occurs when the plants begin to die
- Just like the organic wastes before, in order to decay and break down large amounts of oxygen is required. The river becomes low in oxygen and fish die

Algae bloom


Eutrophication
Nitrogen
Phosphorus
These nutrients cause an increase in phytoplankton
Sediments from land block sunlight
Algae Bloom
Algae Die
Phytoplankton growth on Sedgegrass
Oxygen
Sedgegrass
Decay
Lose: Food, Habitat & Oxygen Production

Natural Fish Kills

- Fish kills may also occur during the summer when temperatures of water rise
- Oxygen is less soluble in warm water
- As oxygen levels reduce, fish are under pressure to breathe and therefore die

Toxicity and the food chain

- Some chemicals e.g. herbicides and pesticides
- This can result in the death of living things as the level of chemical becomes toxic (causes death)
- Some toxins build up and are stored in the adipose tissue (fat) of an animal

- The level of toxins become more concentrated in animals at the top of the food chain, as they feed on organisms that have high concentrations of pesticides
- Humans can be affected if they consume a large quantity of toxic animals

Schemes offered by the Dept of Agriculture

- REPS (Rural Environment Protection Scheme(1994 – 2013)
- FEPS (Forest Environment Protection Scheme) introduced in 2007

Ways farmers can enhance Biodiversity on your farm

- Traditional hay meadows.
- Allow grasses to flower and seed to encourage wildlife

Ways farmers can enhance Biodiversity on your farm

- Protecting hedgerows. Manage and maintain hedgerows.
- You are not allowed to cut hedgerows during bird nesting season
- Maintain existing lakes, marshes, bogs,

Preventing Silage effluent causing pollution

- Allow the grass to wilt
- Collect and store silage effluent in underground pits
- Dilute silage effluent with water
- Spread the effluent on stubble after cutting silage
- Don't spread near waterways

Preventing Run-off from fertilizers

- Make sure the correct type and amount of fertilizer is being applied
- Apply to crop during periods of rapid growth
- Don't apply when it's raining
- Don't apply near a water source

How to spread fertiliser

- Fertiliser should not be applied in the rain
- Should be applied 20 m away from waterways
- Should be applied only between April and august

Bacterial and Viral Diseases in water

- Sometimes bacteria and virsues can end up in a river
- This usually means a farmer hasn't disposed of animal wastes correctly
- The water is not safe for human consumption and must be treated

Organic Foods

- **Organic Food** is basically food produced without the use of pesticides
- **Pesticides** are chemicals that control the level of pests on crops
- Examples of pests are the white fly on tomato crops

Reducing the use of pesticides

- Introduce the red spider mite to tomato plants. This spider feeds on the white fly and will control their numbers
- This is called **Biological control**

The Importance of Hedgrows

- Provide shelter for farm animals
- Are a habitat for wildlife
- Are a food source for wildlife
- Provide protection for crops
- Absorb Carbon Dioxide (Photosynthesis)
- Release Oxygen (Photosynthesis)
- Provide borders to land

Carbon Dioxide

- Carbon Dioxide is a major pollutant on Earth
- Carbon Dioxide causes Global warming (an increase in the earths temperature which will cause severe drought in some areas, severe flooding in others and the destruction of the ice caps and ozone layer)

Increasing Carbon Dioxide Levels

- Increased use of machinery
- Increased levels of livestock
- Burning waste

Decreasing Carbon Dioxide Levels

- Using lower powered machinery
- Sowing more crops than livestock
- Recycling waste rather than burning it

The Carbon Cycle

- The Carbon Cycle is the way in which Carbon is used and reused on Earth

- It's a continuous cycle

- Carbon Dioxide is made up of Carbon and Oxygen
- When animals and plants respire they breathe in oxygen and breathe out carbon dioxide
- Animals eat plants which are full of carbon. The animal now contains carbon

- When plants and animals die they decay. Carbon dioxide is released by micro-organisms during this process
- Sometimes plants will only partly decay. They form fuels instead e.g. Coal and turf
- When fuels are burned carbon dioxide is released

The Nitrogen Cycle

- Nitrogen gas in the atmosphere is in a from that plants cant use
- It must be turned into a form that is usable
- Nitrogen gets turned into Nitrate by bacteria
- This is called Nitrification
- This Nitrate gets absorbed by plants

- 2 options:

1. Plants die and decay releasing the Nitrate as Ammonia
2. Animals eat the plants and when the die and decay release Nitrate as Ammonia gas

- Ammonia gets turned into Nitrite (Nitrification)

- Nitrite gets turned into Nitrate (Nitrification)

- Nitrate gets turned into Nitrogen (Denitrification)