Farming Smart: Precision Agriculture

Technologies and applications for the future of agriculture

VistaMilk

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Course Objectives:

1. To introduce students to the fundamental concept of precision agriculture, as well as the technologies used and its potential benefits
2. To give students an understanding of how drones and image-analysing models are used for monitoring & predicting grass growth
3. To create awareness of how genetics is used in plant breeding

Key words

- Precision agriculture
- Root Zone
- Artificial Intelligence
- Forage
- Cultivars
- Varieties
- High-throughput methods
- Digestibility
- Dry Matter
- Leaching

Teacher Guidelines

1. ***Individual work:*** Students may come up with their own definition of 'precision agriculture'
2. ***Group work:*** Students may work in groups to define the term 'precision agriculture' and to come up with some examples
3. ***Mind Map Activity:*** The class may work together to identify words that they associate with the term 'precision agriculture'

INTRODUCTION

Precision agriculture is the application of advanced technology to improve farming practices and to increase productivity, while also reducing waste. Cutting edge technologies such as sensors, satellites, drones and GPS systems are used in precision agriculture. These technologies provide farmers with information about soil conditions (temperature, pH, moisture levels etc.), crop & animal health and other environmental variables. This allows farmers to make informed decisions about farming practices.

Benefits of precision agriculture include:

- Resources such as water are used more efficiently
- Higher crop yields
- Increased environmental sustainability
- Inputs such as pesticides and fertilisers are applied precisely, resulting in less use of chemicals
- Reduced demand for manual labour

IN THIS COURSE

You will learn about some of the common technologies used in precision agriculture and their applications. There are also four case studies of research that is underway and how researchers use precision agriculture and technology to improve farming

1 **Case study 1 - Drones for Measuring Grass**

Learn how drones can be used to reduce labour and accurately measure grass growth and compostion

2 **Case study 2 - Predicting Composition on Dairy Farms**

Learn how researchers use genetics to improve plant breeding

3 **Case study 3 - Breeding for Better Quality Plants**

Learn about how artificial Intelligence can predict what type of plants are growing in their fields

4 **Case study 4 - Predicting Grass Growth on Farms**

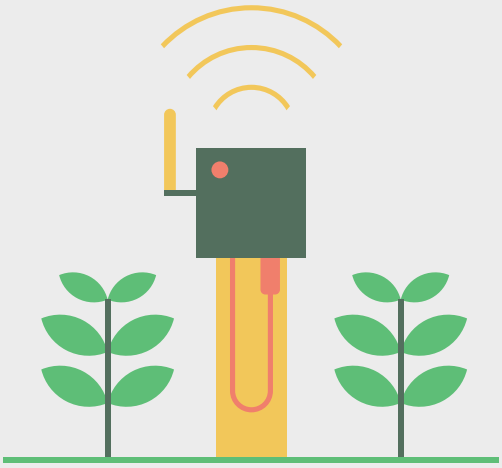
Learn about how scientists currently predict grass growth on farms and use the weather to help their predictions

Examples of Technology Used in Precision Agriculture

Drones

Drones or unmanned aerial vehicles (UAV) are useful tools in precision agriculture. They can map and image crops to determine crop health and monitor moisture levels, disease control, and yield. Drones are also used for seed planting, which is efficient and can reach difficult areas without endangering workers. In Asia, drones are commonly used for spraying selective pesticides, reducing chemical usage and improving pest and weed control. Additionally, drones can recognize dry areas in fields and distribute water accordingly, conserving resources.

Root Zone: the area of the soil that surrounds the roots of a plant



Sensors

A sensor is a device that detects a physical input (eg. moisture, light, motion) from its environment and transforms it into information that can be understood by either a human or a computer. Sensors can be installed below the ground in the root zone in order to monitor the conditions of the soil.

Soil moisture sensors, which measure the water content of the soil, are an important tool used in agriculture to help farmers determine the precise amount of water needed by the crops. Cutting edge satellite sensors can also be used to measure the moisture levels of the ground.

Similarly to humans, crops need nutrients in order to grow and to be healthy. Soil nutrient sensors provide information about how much of a certain nutrient is present in the soil. This allows farmers to apply a precise amount of fertiliser, reducing the use of chemicals.

Automation:

Robots and autonomous machines are increasingly used in agriculture for tasks ranging from picking fruit to monitoring crops and measuring soil pH. Autonomous tractors navigate using lasers, GPS, and wireless technologies, adjust speed, and detect obstructions. Research shows that the use of autonomous machines improves efficiency and productivity, reduces human errors, and alleviates concerns about labor shortages for farmers.

Independent Research: Investigate the origins of artificial intelligence and research other ways that AI has been used in agriculture

Geographic Information Systems (GPS):

GPS can be used in precision agriculture for guiding tractors, mapping of field boundaries, farm planning, and yield mapping. GPS receivers are used to collect location specific information. The accuracy of GPS allows farmers to create farm maps which can be used to pinpoint exactly what areas may be subject to recurrent pest, insect or weed infestations. Farmers can use this information to take the precautions necessary to prevent infestations, saving time, resources and money. Crop dusters, which are a type of aircraft used to spray crops, can be equipped with GPS, allowing them to target areas more precisely.

Think, Pair, Share Activity:
In some countries, in order to use spray drones you must be a licensed operator, why do you think this is? Can you think of any ethical considerations associated with the use of drones?

Artificial intelligence

Artificial intelligence (AI) is used in precision agriculture to analyze data collected from sensors, drones, and satellites, to make predictions or conclusions for better decision making. AI can help farmers determine the best time to plant seeds, how to space and plant them, and identify weed infested areas, suggesting the appropriate herbicides. It can also monitor animal health, diet, and movement to detect anomalies early, enhancing animal welfare and product quality. AI can enable farmers to produce higher yields while using fewer resources.

Artificial intelligence: The replication of human intelligence by computer systems

Questions:

1. Precision agriculture leads to a reduced need for manual labour, can you think of a potential advantage and disadvantage of this?
2. Why do you think it is important to avoid excessive fertiliser/pesticide use?

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CASE STUDY 1

Drones for measuring grass

Farmers are faced with the challenging task of regularly inspecting their fields to monitor grass growth. They pay particular attention to how suitable the grass is for grazing by cows. If the grass is a vibrant green colour, it is a sign of healthy grass. Farmers can also measure grass growth to help them to make more informed grazing decisions. It's a balancing act of ensuring there is enough grass for the cows to eat, without being wasteful or overfeeding them. They also need to avoid under grazing. This process is both labour-intensive and time consuming. Researchers at VistaMilk want to provide farmers with a quicker and easier way to obtain that information.

How much grass does an average dairy cow eat per day?

Researchers are currently testing how accurate image-analysing models are at measuring grass growth. These models use photos captured by drones and static cameras. The goal is to predict how much (quantity) and what kind of grass (variety) will grow in pastures. This innovation is designed to help farmers determine when and where to allow their cows to feed. To date, the models are 95% accurate at predicting grass growth based on a single photograph.

It is important for farmers to continuously monitor their paddocks. Not only do they need to observe how their grass is growing but also they need to be familiar with what other plants, such as clover, may be growing in their paddocks. Knowledge of this can make a huge difference to the profitability and sustainability of a farm by reducing the need for chemical fertilisers and improving the quality of winter silage. This leads to increased milk yields and reduced costs. The use of image analysis will improve the accuracy of this process,making it easier for farmers to make informed decisions on how to manage their fields more effectively.

Name two methods of grass conservation

Questions:

1. Do you think the use of drone technology in agriculture has any drawbacks?
2. Can you think of any other ways that drone technology could be used in agriculture, besides the examples given above?
3. What barriers do you think might prevent this technology from being used?

Group Activity

Divide the class into groups. Each group should be given a current grass measuring method, ask them to research their assigned method and give a brief description of how it is used, outlining 1 advantage and 1 disadvantage of the method. Each group should then their findings to the class.

Relevant Exam Questions

2020 LC Agricultural Science Sample Paper - Section A Question 6

Technology advances in agriculture have allowed farmers to practice sustainable agriculture while also becoming more productive and innovative with crop and animal production.

(a) The use of drones could aid farmers in crop production.

Describe how the use of drones could help with direct and indirect control of pests or diseases or weeds.

Direct control:
Indirect control:

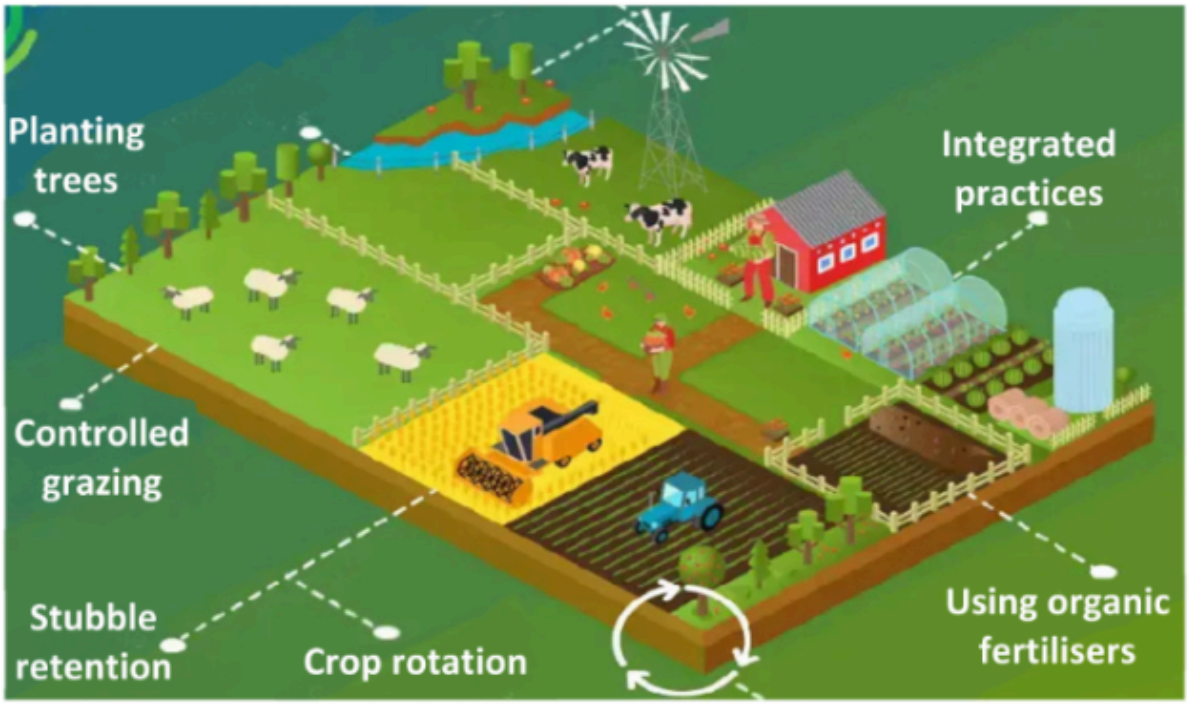
(b) Apart from drones, identify **one** role biotechnology applications have in animal science.

Relevant Exam Questions

2023 LC Agricultural Science Ordinary Level Section 1 Question 4

Question 4

The diagram shows some regenerative farming practices.
Analyse the diagram and answer the questions which follow.



Outline **one** reason why each of the following farming practices is carried out.

Controlled grazing (management of forage with grazing animals):

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CASE STUDY 2

Predicting Composition on Dairy Farms

Compositional data can be found in many aspects of the dairy industry. Whenever we see percentages and proportions of the different components of a material, we call them compositional data. For example, the components in a meat sample, namely, moisture, fat and protein, when expressed in percentages are compositional in nature and so are the percentages of fat, protein, and calcium content in milk. Perennial ryegrass is used as fodder for cows and is usually grown with clover in paddocks because clover has the ability to convert atmospheric nitrogen into a usable form for plants in the soil and thus reduce the amount of chemical fertilizers used by farmers. It does this through a symbiotic relationship with bacteria in the roots of clover.

What components of a sward would a farmer want to measure?

Name 3 different varieties of grass sown on Irish farms

Paddocks can sometimes have unnecessary weeds that compete with grass for the soil resources. The percentage of dry matter weights of the individual components collected from a standard sized patch in a paddock are compositional data. It is important to estimate the individual components in a paddock accurately to determine optimal seeding density, for targeted fertilizer application and also timely intervention to eliminate weeds.

Compositional data refers to information structured as proportions or percentages of a whole, and specialized analysis methods are required because these components are related to each other.
Symbiotic relationship: A mutually beneficial relationship between two or more organisms.

Machine learning: A type of artificial intelligence (AI) focused on building computer systems that learn from data.

Compositional data can lead to many challenges for predicting data using machine learning. Most paddocks in Ireland will be dominated by the presence of grass and many patches may not have weed presence. This skews the proportion of data available for building machine learning models. For example, one paddock might have 82% grass, 14% clover and 4% weeds, whereas another might have 68% grass, 31% clover and 1% weeds. Many samples may not have weeds at all. So the models may not have sufficient representation of weeds in the samples collected from which they can learn to predict efficiently. Another problem is the scale of errors in the prediction models.

The algorithm can predict better the component that is most abundant but predicts poorly components that are less common. New research is looking at ways of improving this imbalance. Such research will contribute to estimate the individual components more accurately, thereby enabling farmers to make reliable decisions on the grass-clover mix, minimise the fertilisation costs and improve weed management.

Questions:

1. Why might a farmer want to predict the composition of a paddock?
2. How might inaccurate predictions affect famers decision making?

Research Activity

You are a researcher in predicting sward composition. You want to know what do farmers want to be able to predict and how often. Develop a short survey with questions you would use to ask a farmer in order to get the information you need for your project.

Relevant Exam Questions

2021 LC Agricultural Science Ordinary Level - Section B Question 18

(iii) Farmers are increasingly using Global Positioning Systems (GPS) when spreading chemical fertiliser on the land.

Outline **two** advantages of using this technology when spreading chemical fertiliser.

1.
2.

2023 LC Agricultural Science Higher Level - Question 9

(a) Read the article and answer the questions which follow.

The *Farmdroid* has landed in Ireland

The *Farmdroid*, which won the National Ploughing Championship 2022 machine of the year is a fully functioning solar powered field vehicle that automates sowing and mechanical weeding. The core principle of the machine is that it relies on GPS location data to go about its daily tasks.

The tasks of sowing and mechanical weed control in crops are guided by precision GPS. Using this GPS, the *Farmdroid* can sow the seeds far enough apart to note and record where each individual seed has been planted in a field. The company claims that accuracy is to within 8mm, allowing even pre-emergence hoeing of the soil both between the rows and in between the plants themselves in most crops.

(Adapted from Agriland, 2022)

(iii) Apart from GPS, outline **one** piece of technology that you have studied that would benefit both the farmer and the environment.

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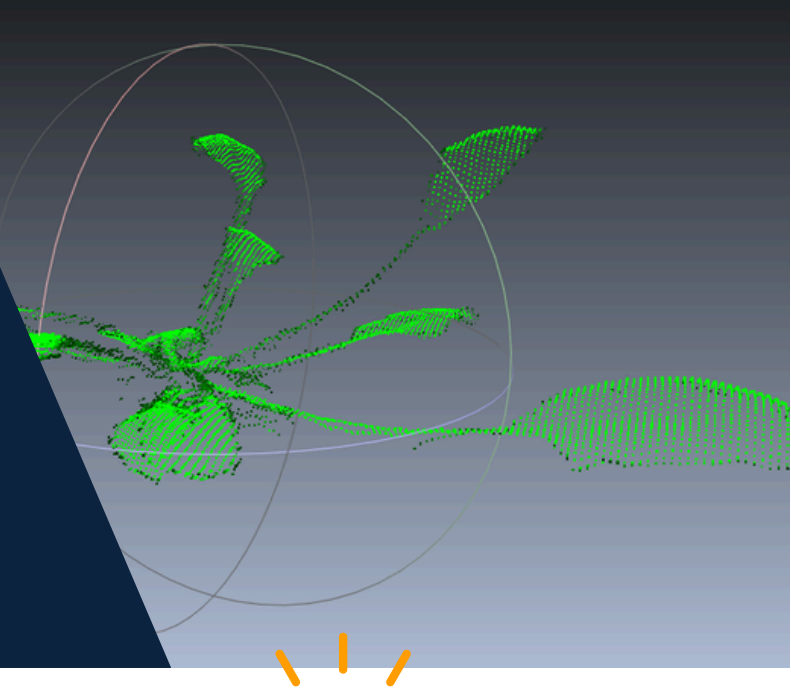
CASE STUDY 3

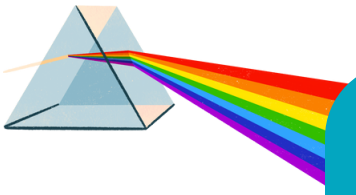
Breeding for Better Quality Plants



Ireland has a grass-based system of dairy farming, which means cattle spend a lot of time grazing in fields. In order to ensure that there is enough high quality grass available to the animals, farmers sow grass cultivars that have undergone testing for several years in field trials. This ensures the best quality. One of the most important traits of a grass cultivar is high yield production during springtime. This makes sure that there is enough grass available to meet demand during calving season in the spring. Other important traits include the nutritional value and digestibility of the grass. Research has shown that grass which is more digestible leads to higher animal performance and reduced methane emissions.

How do cows digest grass?
Why is the digestibility of grass important information for a farmer?

In order to improve the quality of grass, traditional methods of selection can be used.
The goal is to select the best quality plants based on desirable characteristics (such as high nutritional value or greater digestibility) to breed a new generation of higher genetic quality plants. As time goes on, new generations of offspring populations can be improved and even new cultivars can be developed. The rate of improvement is known as the genetic gain, and it is calculated on an annual basis. The higher the number of parent plants used in the selection process, the more accurate the process of determining the desired traits is, resulting in greater genetic gain.



Near Infrared Reflectance Spectroscopy (NIRS): is a spectroscopy technique that uses near-infrared ranges of the light spectrum. "Near infrared" light is closest in wavelength to visible light.

Plant phenotypes can also be determined using high-throughput methods. An example is the use of a grass harvester, fitted with an NIR spectrometer. Researchers at VistaMilk have used near infrared reflectance spectroscopy (NIRS) to obtain scans of grass samples in a field trial. The grass samples were then analysed and laboratory methods were used as a reference to determine how digestible the grass is and also to provide information on the grass composition.

Grass phenotyping with NIRS allows for faster analysis of grass samples and a more accurate selection of parent plants. Better quality grass (i.e. of increased digestibility), will reduce the need for additional inputs by farmers, leading to an increase in profitability and environmental sustainability. This will result in higher value produce to address the growing consumer demand for sustainable food production.

Questions:

1. Other than grass quality, what other factors might affect the standard of produce such as milk and meat?
2. Can you think of any other traits that might be selected for in order to improve the quality of grass?

Revision Activity

From Junior Cert science can you remember what the following terms mean? Write the definition for each.

1. Phenotype
2. Gamete
3. Genetics
4. Heritability

Relevant Exam Questions

2023 LC Agricultural Science Ordinary Level Section 2 Question 18

Question 18

(a) Read the article and answer the questions which follow.

DNA evidence proves Welsh farmer stole neighbour's cow

A farmer in Wales was fined £4,000 after DNA evidence was used to prove he had stolen his neighbour's cow, police have said.

The £3,000 heifer was re-tagged by his neighbour and claimed it as his own after it escaped from a neighbouring field.

Police said it has become the first police force in the UK to use DNA evidence from a stolen cow in a resulting criminal court case.

The cow's real owner reported one of his 300 cows had been stolen in December 2017 after spotting it in his neighbour's field, despite the farmer denying he had seen it. The farmer provided police with a cow passport, listing ear tag numbers for the cow and the animal he claimed was its mother.

A warrant was issued for the cow and blood samples taken from it were successfully matched with other cows from its original farm, and his neighbour was charged.

(Adapted from RTE, 2020)

(iii) Briefly describe another innovative method used on farms you have studied.

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CASE STUDY 4

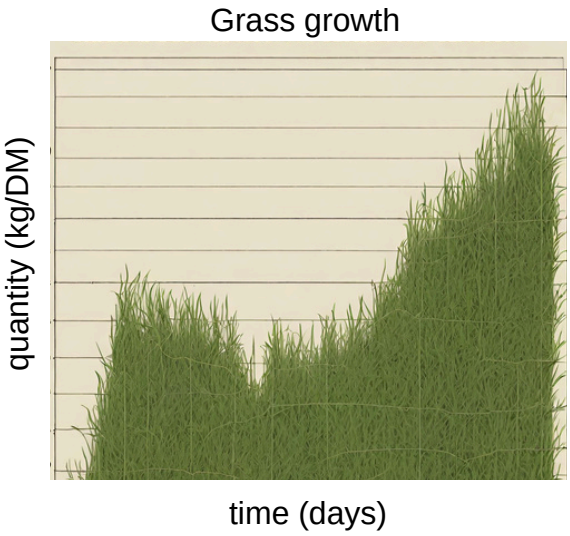
Predicting Grass Growth on Farms

Pasture management is an important part of dairy farming in order to ensure that livestock have enough high quality feed, both during the grazing season and during the housing period. If pastures are not managed well, farmers will have to buy supplementary feeds that are less sustainable and more costly. Each week, farmers are faced with the task of estimating grass growth for the coming seven days. This is a difficult and time-consuming task. However, the development of the Moorepark St Gilles Grass Growth (MoSt GG) model to predict grass growth, enables farmers to make more informed decisions.

The MoSt GG model is currently being used on 84 farms nationwide to predict grass growth every week and allows farmers to make informed management decisions. Each additional kilogram of grass dry matter utilised on a farm leads to an increase in profits. For each farm, data has to be provided, this includes paddock area, grazing and cutting dates, number of grazing animals (stocking rate), nitrogen fertilisation rate, and date of application. Other data that is required includes the soil type for each paddock and forecast weather data.

Dry matter: The fibre, protein, minerals, carbohydrates, and other nutrients found in grain or forage after removing all moisture

How would you calculate the correct stocking rate for a paddock?

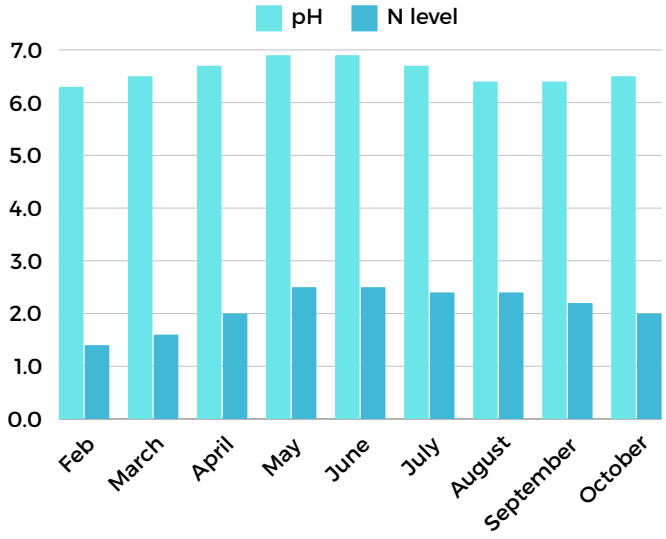


QUESTIONS

A scientist used a soil sensor to monitor pH and nitrogen levels in soil over a grazing season. Chemical N fertilizer was applied during the season.

1. What was the average pH of the soil over the season?
2. Did the Nitrogen level increase or decrease over time?

The scientist wants to know when the fertilizer was applied. using the data, determine in what month the chemical fertilizer was applied to the soil.



Based on the three case studies can you find similarities between the research? What is the aim of each case study and why do you think there is a research focus on it. Propose a hypothesis for one of the case studies and give one limitation of the scientific method that could apply to that case study.

KEY WORDS

Precision agriculture: The science of improving crop yields and assisting management decisions using high technology sensor and analysis tools.

Forage: Food used to feed animals such as cattle and horses.

High throughput: The use of automated equipment to rapidly test thousands to millions of samples for biological activity at the model organism, cellular, pathway, or molecular level.

Dry matter digestibility (DMD): The portion of the dry matter in a feed that is digested by animals at a specified level of feed intake.

Leaching: the loss of water-soluble plant nutrients from the soil, due to rain and irrigation.

The MoSt GG model has also been developed to predict the nitrogen content of the grass as well as nitrogen leaching. This can be used to predict the impact of different grazing management strategies on the paddocks. Feedback on the model is very positive with 70% of farmers said they had adjusted their management based on the predictions.

PastureBase Ireland (PBI) is the Irish grassland management decision tool available to all farmers. It helps them to manage the grass on their farms, identify surpluses or deficits in the supply of grass, allowing them to take appropriate action. At present, PBI is based on historical information. The aim is to incorporate the MoSt GG model into PBI, allowing any farmer who enters the required information weekly to obtain accurate predictions for their farm. The integration of grass growth predictions into PBI has huge potential to help farmers make better grassland management decisions based on the future grass growth.

Questions:

1. Give a reason why it is unsustainable for farmers to buy supplementary feed when pasture management is poor.
2. Why is it important for farmers to provide information about soil type in order to predict grass growth?

Think Pair Share

Chemical Nitrogen fertilizer applications are limited due to environmental concerns.
How might a farmer increase the nitrogen in the soil without using chemical fertilizer?

Relevant Exam Questions

2022 LC Higher Level Agricultural Science - Section 2 Question 13

Question 13

(a) Maintaining a constant supply of high quality leafy grass can be easily achieved by managing and measuring the amount of grass on the farm.

(i) Outline **two** advantages of grass measuring.

1.
2.

Relevant Exam Questions

2023 LC Agricultural Science Higher Level Section 2 Question 13

(d) Read the article and answer the questions which follow.

VistaMilk using satellites to collect real-time data on farm soils

Satellites are being used to collect real-time information about soil moisture on Irish farms by *VistaMilk*, the research centre at Teagasc, Moorepark.

The research project is utilising imagery from the European Space Agency's *Sentinel* satellites to map soil moisture in Ireland, with the capability of focusing in on areas as small as $10m^2$.

The data gathered could be used to help farmers make decisions about which fields to allow their livestock feed in while maintaining optimal grazing and grass growth, which requires drainage or even wetting, and potentially when to add or reduce use of fertilisers and slurry.

The data collected can be used to identify areas of a farm that are adversely affected by prolonged periods of wet or dry weather.

(Adapted from Farmers Journal, 2022)

(i) Explain how the data gathered could help management decisions on the farm in relation to the drainage or wetting of land.

Farming Smart: Love your livestock

Technologies and applications for the future of agriculture

Course Objectives:

1. To introduce students to the importance of welfare in agriculture
2. To give students an understanding of how sensors can be used to monitor livestock
3. To make students aware of the selection process for specific traits in dairy cow breeding

Key Words

- Ruminate
- Accelerometer
- Carbon Footprint
- Culling

INTRODUCTION

Animal welfare is concerned with the wellbeing of animals and can be studied
through observations of animal behaviour and physiology. Good farm animal welfare is an important part of Irish farming. Animal welfare is strongly regulated in Ireland through the Department of Agriculture, Food & the Marine (DAFM) cross-compliance inspection system, which all Irish farmers have to comply with.

Good animal welfare practices:

1. Animals should be provided with fresh water and the right amount of feed to keep them healthy.
2. Animals should have the right kind of environment, they should have shelter and somewhere comfortable to rest. Farmers need to make sure the environment is not too hot or cold and that animals have enough space for grooming, stretching and exercise.
3. Farmers should try to prevent animals from getting ill but if they do fall ill, the animals should be diagnosed and treated rapidly.

IN THIS COURSE

You will learn about some of the common technologies used in precision agriculture and their applications. There are also 3 case studies of research that is underway and how researchers use precision agriculture and technolligy to improve farming

Teacher Guidelines

Brainstorm activity: Students may work in small groups to identify good animal welfare practices

Before introducing the 'Livestock Sensors' case study, students may be asked to think of the different behaviours they would observe if a cow was sick/stressed

1 **Case study 1**
Livestock sensors

2 **Case study 2**
Dairy cow breeding

3 **Case study 3**
Calf welfare

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CASESTUDY 1

Livestock Sensors for Monitoring Health

The health and welfare of livestock is important due to ethical reasons but also to ensure that produce is safe and of high quality. In particular, young calves are prone to becoming sick. The early detection of stressful events and disease conditions in animals is vital for calf health. However, it is impractical for farmers to continuously monitor their livestock 24/7. The problem is the lack of tools to assist farmers in managing the health and welfare of livestock on farms.

In recent years, research has focused on better understanding animal behaviour. This has led to the development of activity sensors for monitoring livestock, in particular cattle. By attaching a sensor to the cows, we can learn about their activities during the day. The sensors can provide us with information on how long they graze, rest, play and ruminate. It's a similar principle as our smart watches! The information provided by the activity sensors tells us a lot about the cow's health. For example, we know that lame cows spend more time lying down or sick cows spend less time grazing.

Additionally, the continuous monitoring of cow's grazing behaviour gives farmers an indication of how much they need to feed them, allowing resources to be used more efficiently. Monitoring of feeding, drinking or lying behaviour can also help to detect reproductive events such as calving, therefore contributing to better reproductive performance on the farm.

During the first few months of their lives calves are vulnerable to certain diseases. Calf activity changes when they are sick or stressed. For example, calves that are sick spend more time lying down.

Accelerometer: A device that measures acceleration of motion

? Why is weather data needed for the model?

Udder sensors can check the quality of milk. Outline two advantages of this technology.

The goal is to generate an alert when a disturbance is detected (i.e. when the animal is sick or stressed). Once the sensor receives information that a cow has a problem, it then communicates that with the farmer to tell them. AI is used to analyse the information about the cows from the sensors. Several sensor types are used to monitor animal behaviour but 3-D accelerometer sensors seem to be the most promising as they are small enough not to alter the behaviour of the cattle. The sensors can be attached to different positions on the cow's bodies, the most common being the neck, leg or ear.

The use of sensors to identify stress and illness in livestock is a remarkable achievement and a major advancement in the area of precision agriculture. By allowing farmers to continuously monitor their livestock, they can save money due to the reduction in the cost of treating sick animals. Overall, the use of sensors leads to an improvement in animal health and welfare.

Questions

1. Why do you think sensors are most commonly attached to the cow's neck, leg or ear as opposed to other areas of the body?

2. Outline one advantage of measuring tail movements triggered by labour contractions.

Farmers can determine the movement of their cows using the pedometer where increased activity indicates a cow is in heat. State the duration of oestrus and advise the farmer of the best time for insemination.

Give coding a try with VistaMilk's coding for cows online game!

Relevant Exam Questions

2022 LC Agricultural Science Ordinary Level Section 2 Question 17

Question 17

(a) Read the article and answer the questions which follow.

Robotics and Automation in Agriculture

The future of farming will likely be in automation, using robotic and self-driving machinery to sow, fertilise and harvest crops or manage animals. Already, automated or robotic milking machines are in use in Ireland and over 50% of all new milking machines installed in the European Union (EU) are automated.

Robotic milking has a number of advantages. There is more consistency, reduced labour costs, the possibility of increased milking frequency (three times a day) and better overall herd management.

(Adapted from Science and Technology in Action, 2013)

(i) Outline **two** advantages of technology in agriculture.

1.
2.

2022 LC Agricultural Science Higher Level Section 2 Question 15

(ii) Outline **one** piece of technology that has been installed in animal housing that you have studied that improves the welfare of the animals.

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CASESTUDY 2

Dairy Cow Breeding

Improving the lifespan of dairy cows has been a focus of research since the 1950s. Longevity traits are now included in most dairy cow breeding programmes. If dairy cows live longer then there is a reduced need for replacement cows to maintain herd size, leading to an increase in profitability. Improved longevity is also likely to reduce the carbon footprint of milk production. However, selection for dairy cow longevity remains challenging as it is difficult to predict a cow's lifespan.

Carbon footprint: The total amount of greenhouse gases that are generated by our actions

Progressive age-related deterioration in health and fitness is common across most animal species, including dairy cows. Reduced muscle mass is a major health concern in the elderly human population and has also been observed in older dairy cows. Age-related deterioration also contributes to mastitis, which is a disease that causes severe inflammation of the mammary gland and udder tissue of dairy cattle. It usually occurs as an immune response to bacterial invasion of the teat canal and can also occur as a result of chemical, mechanical, or heat injury to the udder. Mastitis is commonly reported as the main reason for culling in older dairy cows.

? What other factors can cause mastitis?

Culling: The removal of undesirable animals from a herd

Improving Dairy Cow Longevity for Greater Productivity and Profitability

One reason for dairy cow culling is low milk yield. However, selecting cows that maintain their maximum milk production as they age can reduce the need for premature culling and improve dairy cow longevity. This not only extends the productive life of cows but also leads to higher herd revenue as mature cows produce more milk per lactation and heavier male calves for sale.

By reducing age-related deterioration of cows and maintaining high milk production, farmers can achieve longevity, which means they won't have to replace their cows as often, thereby reducing farm costs.

Questions

Over recent years the use of sexed semen is increasing in popularity and can now be carried out in the new Irish laboratory in Cork. Sexed semen involves scientists identifying and isolating the X and Y chromosome present in the sperm.

Outline the advantages of using sexed semen on farms.

GROUP ACTIVITY

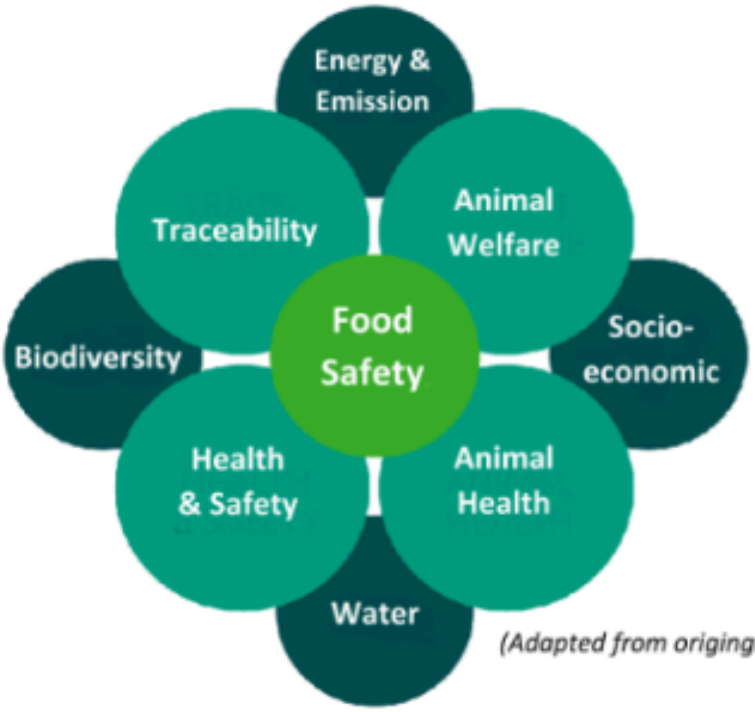
Group research & presentation on animal diseases.
Divide the class into small groups. Each group is given a disease to research.
Create a short presentation to present to the rest of the class explaining what the disease is, what animals it affects and how it is treated.

Relevant Exam Questions

2022 LC Higher Level Agricultural Science - Section 2 Question 18

Question 18

(a) *Origin Green* is Ireland's pioneering food and drink sustainability programme. On-farm assessments constitute a key component of the programme. Analyse the diagram showing the key components of the programme and answer the questions which follow.



(Adapted from origingreen.ie, 2021)

(i) Briefly describe how each of the following key components relate to food safety.

Animal Welfare:

Health and Safety:

Animal Health: