smart skills
smart sustainable agriculture

Course 5: Climate-Smart Agriculture (CSA) Techniques

M5: Reducing Emissions in Livestock and Crop Systems

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This module introduces practical strategies to reduce greenhouse gas emissions (GHGs) in agriculture, focusing on livestock management, crop fertilization, and energy use. The goal is to support climate-smart farming practices that lower environmental impact while maintaining productivity.

01 Lowering Methane Emissions from Livestock Through Feed Adjustments

02 Reducing Nitrous Oxide Emissions with Precision Fertilization

03 Integrating Renewable Energy to Minimize the Carbon Footprint of Farm Operations

04 Let’s Practice!

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What will you learn

By the end of this module, learners will be able to:

- Identify feed strategies to reduce methane emissions from livestock.
- Understand how to lower nitrous oxide emissions using precision fertilization.
- Explore how renewable energy integration reduces the carbon footprint of farm operations.

01

LOWERING METHANE EMISSIONS FROM LIVESTOCK THROUGH FEED ADJUSTMENTS

Why Reduce Methane from Livestock?

Livestock, especially ruminants (cows, sheep), produce methane (CH_4) during digestion.

Climate-smart feed strategies help reduce emissions **without lowering productivity**.

Methane is a powerful greenhouse gas—**25x more potent than CO_2**.

Feed Strategies to Cut Methane

Improve forage quality

- Harvest earlier for better digestibility = less methane per kg of milk or meat.

Add fats and oils

- Lipids suppress methane-producing microbes in the rumen.
- Example: Adding 10g of fat/kg of feed can cut CH_4 by ~1g/kg DM

Use natural additives

- **Tannins** and **essential oils** can reduce methane by up to **50%**.

Precision feeding

- Balance protein and energy to avoid nitrogen losses and boost efficiency.

The livestock sector

is one of the main contributors to global methane & other GHG emissions.

Better management practices related to:

- feed
- husbandry
- grazing
- manure

Livestock and enteric methane - YouTube

02

REDUCING NITROUS OXIDE EMISSIONS WITH PRECISION FERTILIZATION

Why Nitrous Oxide Matters

Nitrous oxide (N_2O) is a potent greenhouse gas—nearly 300 times more powerful than CO_2.

It's mainly released from excess nitrogen in fertilizers that is not absorbed by crops.

Precision fertilization = better nutrient use + fewer emissions + cost savings.

Smart Fertilization Practices

Right dose

Apply nutrients based on crop needs and soil tests.

Right timing

Avoid fertilizing before heavy rain to prevent runoff.

Right placement

Place fertilizers near roots to improve uptake.

Slow-release fertilizers

Reduce leaching and nitrous oxide formation. Use organic fertilizers!

03

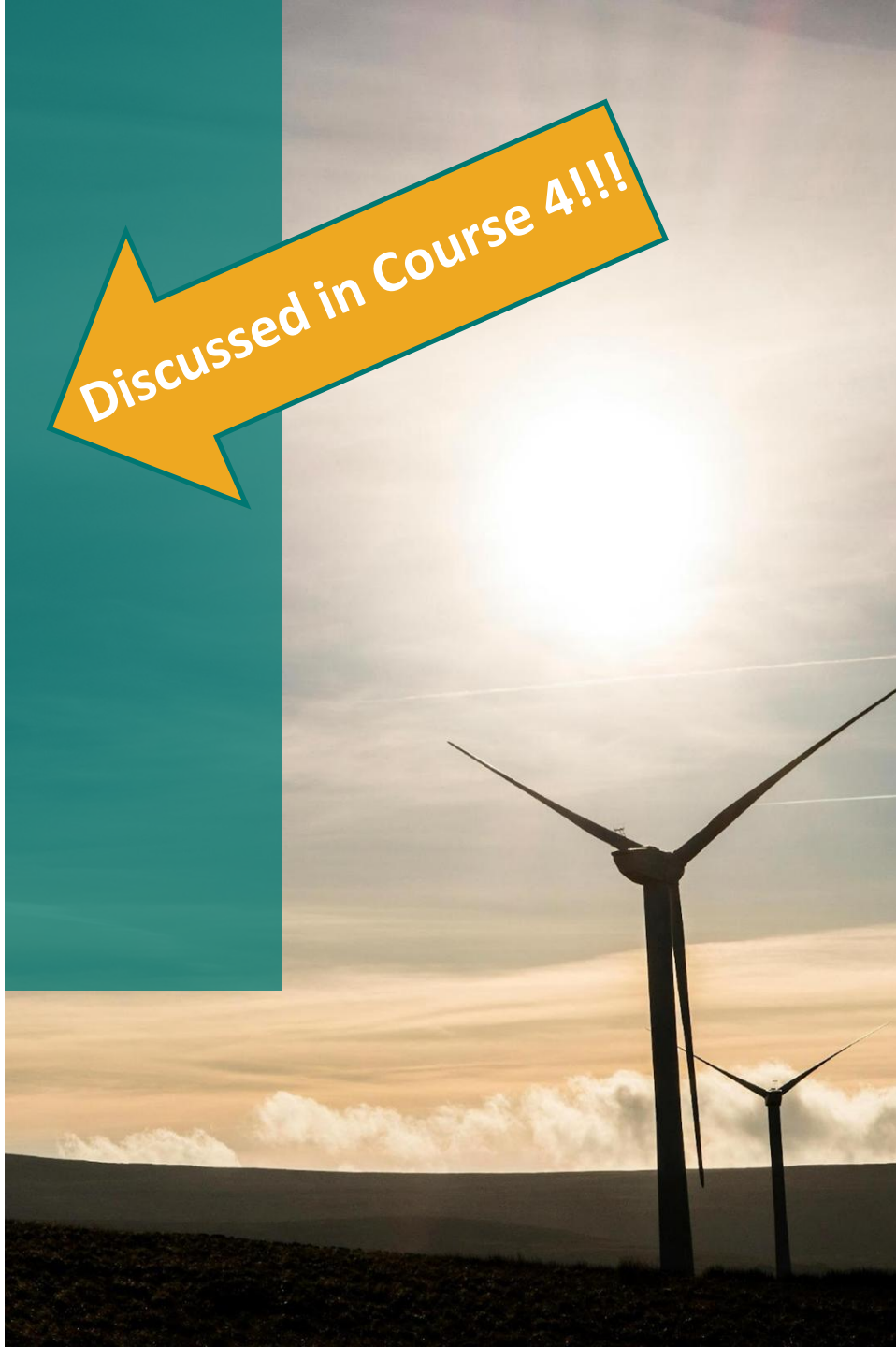
INTEGRATING RENEWABLE ENERGY TO MINIMIZE THE CARBON FOOTPRINT

Why Renewable Energy on Farms?

- Farm operations (irrigation, machinery, storage) often rely on **fossil fuels**, contributing to **CO_2 emissions**.
- Switching to **renewable energy** reduces the carbon footprint and operational costs.
- It also increases **energy independence**, especially in remote or off-grid rural areas.

Types of Renewable Solutions

- **Solar panels** – Power irrigation pumps, lights, electric fencing.
- **Biogas** – Use animal manure or crop residues to produce energy for cooking, heating, or electricity.
- **Wind energy** – Suitable for open landscapes to power small farm equipment.
- **Energy-efficient technologies** – Combine renewables with LED lighting, low-energy coolers, or electric tractors.
- **Smart integration** – Use sensors and timers to reduce waste and maximize energy use.



04

LETS PRACTICE

Farm Emissions Challenge

Scenario: You manage a mixed farm (crops + dairy cows) and want to reduce your greenhouse gas emissions while maintaining productivity.

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Why Renewable Energy on Farms?

What combination of practices should you apply first?

Option A

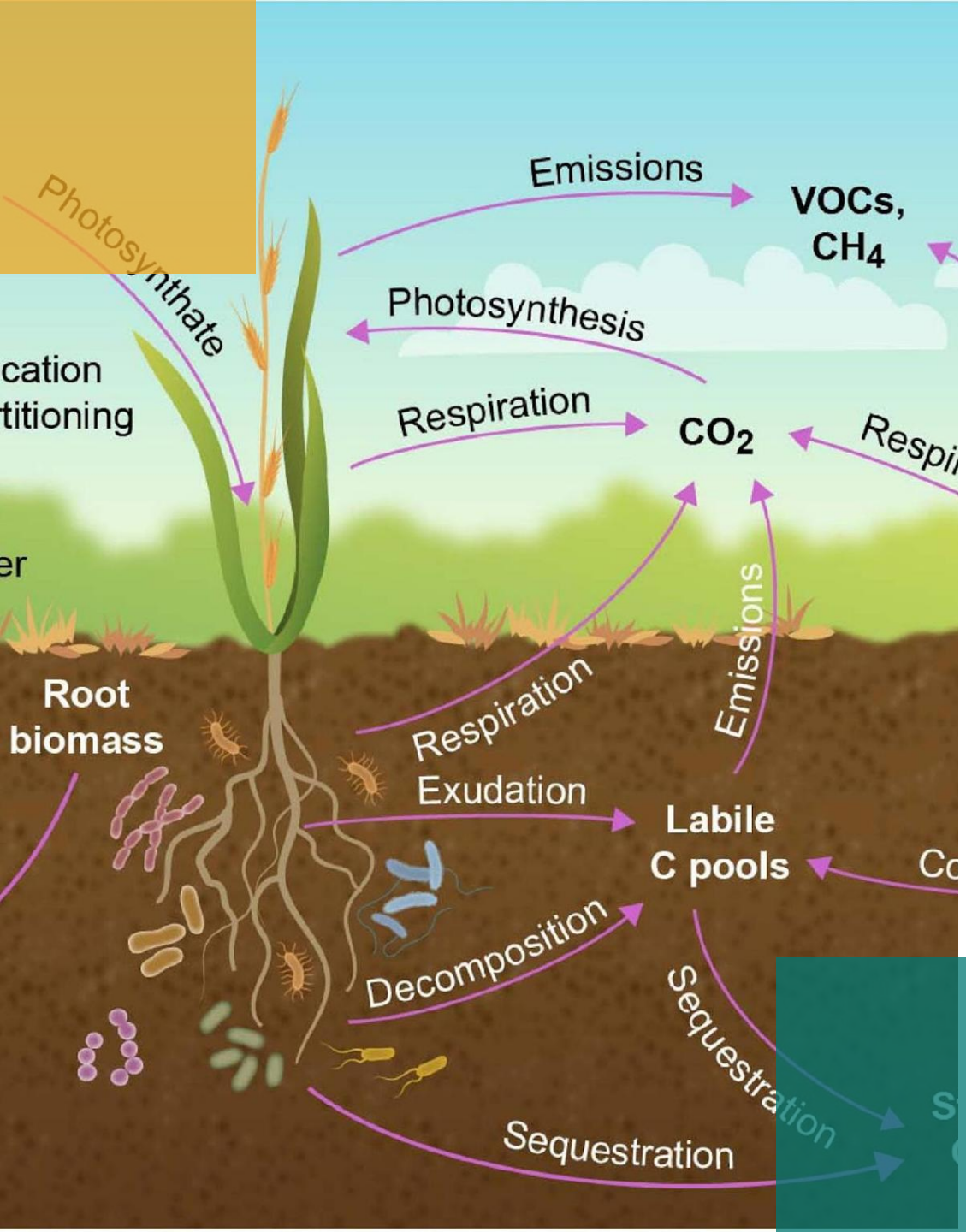
- Feed cows high-protein diets year-round
- Use synthetic fertilizers without testing
- Power irrigation with diesel pumps

Option B

- Introduce tannin-based additives in cattle feed
- Apply slow-release fertilizer based on soil tests
- Install solar panels for irrigation

Option C

- Harvest hay later for better volume
- Use more fertilizer to ensure yield
- Replace cover crops with bare fallows



Feedback

Correct Answer: Option B

This option reflects a **climate-smart approach**:

- Reduces methane with feed additives
- Lowers nitrous oxide emissions with precision fertilization
- Cuts CO_2 through renewable energy use

Well done!

You're now ready to apply CSA principles on your farm, in your classroom, or in your community!

You've completed the journey through Climate-Smart Agriculture Techniques!

In this final module, you explored how to:

- Reduce methane emissions through smart livestock feeding
- Cut nitrous oxide by applying precision fertilization
- Use renewable energy to power farm operations sustainably

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Make your last step!

Your final Smart Skills course will be: "**Bringing Innovation to Farms".** This module aims to provide you with a comprehensive **introduction to control systems in agriculture!**

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