The Impact of Climate Change Mitigation Policies on the Agriculture Sector in Ireland - A CGE Analysis

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Motivation & Policy Relevance

- Ireland's Agriculture Sector is heavily dominated by Cattle and Dairy Production
  1. Dairy 32.1%
  2. Cattle 29.8% (by output)
- Share of National GVA:
  - Primary Agriculture: 0.94%
  - Food Processing: 2.17%
- Agriculture is Ireland's largest GHG emitting sector (37.9% of national emissions in 2024)
- Agricultural Emissions
  1. CH_4: 71.2%
  2. N_2O: 22.1%
  3. CO_2: 6.7%

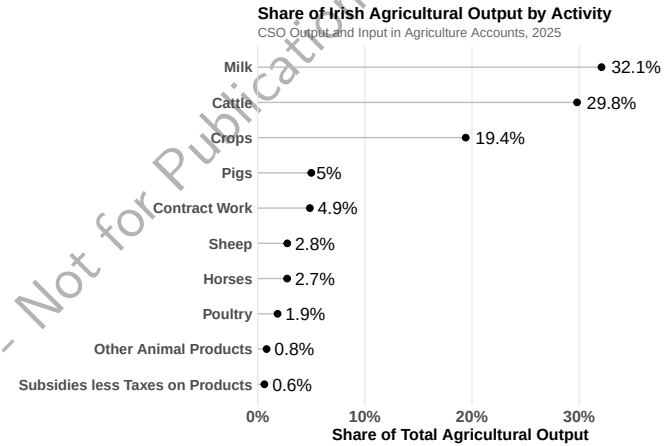


Figure 1: Share of Irish Agricultural Output by Activity.

Source: Central Statistics Office (2026)

Motivation & Policy Relevance

- Climate Action Plan (Government of Ireland, 2025) initiated in 2019
- Target to reduce Agriculture Emissions by 25% by 2030, relative to 2018 levels
- 21.4 $\xrightarrow{25\%}$ 16.1 MtCO_2eq.
- 2024: 20.4 MtCO_2eq.

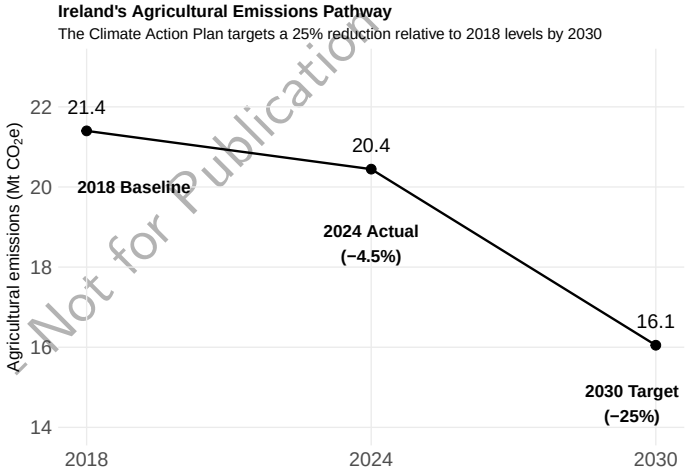


Figure 2: GHG Emissions Reduction Pathway, established by the Climate Action Plan (Government of Ireland, 2025).

Source: Environmental Protection Agency (2026)

Objectives of this Study

Research Question: What are the economy-wide impacts of imposing shocks to indirect taxes on Ireland's cattle and dairy sectors, as a mechanism to reduce agricultural emissions?

- We examine a series of 10 Shocks to Indirect Taxes on Cattle and Dairy Sectors
- Analyse both the Economic Impacts and Impacts on GHG Emissions for Agriculture

Table 1: Shocks to Indirect Taxes in CGE Model

10 Shocks to Indirect Taxes	
05% Tax on Cattle	05% Tax on Dairy
10% Tax on Cattle	10% Tax on Dairy
30% Tax on Cattle	30% Tax on Dairy
50% Tax on Cattle	50% Tax on Dairy
10% Tax on Both	30% Tax on Both

Agriculture-Focused SAM for Ireland 2019 - Data Sources

- Central Statistics Office National Supply and Use Tables 2019
- Teagasc National Farm Survey 2019 (Farm-level data for 886 farming households, representative of the Irish agriculture sector)
- Eurostat Database
- Food and Agriculture Organisation of the United Nations (FAOSTAT)
- COMTRADE Database
- Government of Ireland Publications
- Additional CSO Survey Data (incl. Household Budget Survey)

Agriculture-Focused SAM for Ireland 2019 - Account Disaggregation

Agriculture Activities (12)	
1. Cattle	7. Potatoes
2. Milk	8. Forage Plants
3. Sheep	9. Other Crops
4. Pigs & Poultry	10. Agri. Services
5. Cereals	11. Forestry
6. Fruit & Veg.	12. Fishing

Food Processing Activities (9) + Other Activities (2)	
1. Meat processing	7. Beverages
2. Dairy products	8. Oils & fats
3. Grain milling	9. Other food products
4. Sugar	
5. Seafood processing	1. Manufacturing
6. Bakery products	2. Services

Household Accounts (8)	
1. Cattle Rearing	5. Tillage
2. Cattle Other	6. Other Farming
3. Dairy	7. Rural Non Farming
4. Sheep & Veg.	8. Urban

Factors of Production (4)
1. Paid Labour
2. Unpaid Labour
3. Land
4. Capital

Static Applied General Equilibrium (STAGE) 2 Model

STAGE 2 CGE Model, developed by McDonald (2015), solved in GAMS

Closure	Assumption
Numeraire	CPI fixed
Factor Markets	Full employment, mobile factors
External Sector	Fixed world prices, flexible exchange rate
Government	Tax rates, expenditure and transfers fixed
Fiscal Closure	Government savings adjust endogenously
Policy Instrument	Production tax shocks

Table 2: STAGE 2 CGE Model Closure

STAGE 2 CGE Model: Structure

- **Production technology:** Nested CES structure combining value added and intermediate inputs, with CES substitution among primary factors.
- **Trade:** Standard Armington structure distinguishing domestic and imported commodities, with substitution elasticities calibrated from GTAP.
- **Emissions:** (Initial examination of CH_4 emissions only) Sectoral CH_4 emissions calibrated using GTAP agricultural totals and disaggregated across activities using FAOSTAT emissions shares.

Production Impacts - Immediate Effects

- Immediate Production Impacts are as expected
  - Cattle Output ↓
  - Dairy Output ↓
- Downstream Food Processing reductions
  - Beef Production ↓
  - Dairy Production ↓
- In general, there is a greater impact on Cattle & Beef

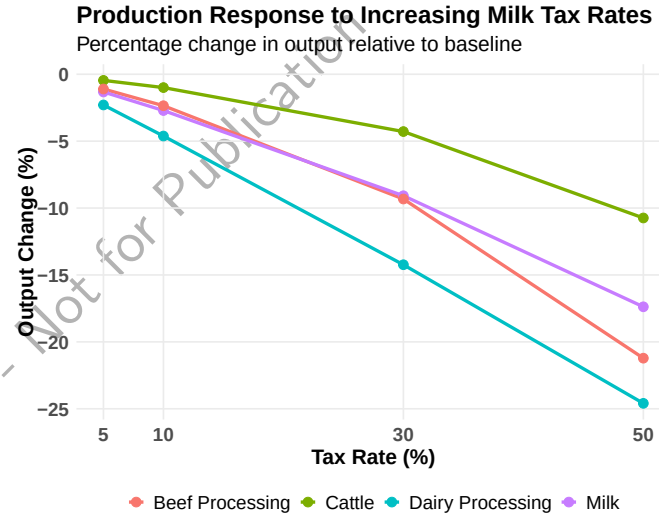


Figure 3: Impact of milk shocks on cattle and milk production and downstream beef and dairy processing.

Production Impacts - Immediate Effects

- Under shocks to Cattle:
  - Milk Output ↓
  - Dairy Processing Output ↑
- SAM Intermediate Inputs:
  - Milk is an input for Beef Production
  - Milk Prices ↓ as Cattle Tax ↑
  - Milk becomes cheaper as an input for Dairy Processing Activity

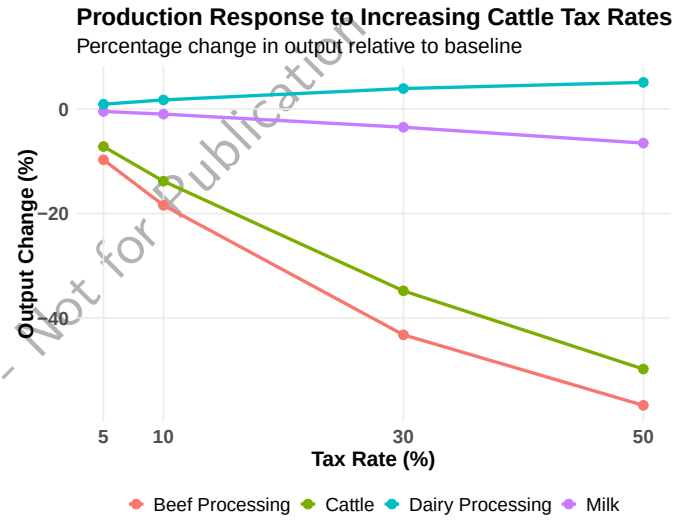


Figure 4: Impact of cattle shocks on cattle and milk production and downstream beef and dairy processing.

Production Impacts - Livestock Related Activities

- **Example:** 30% Tax on Both Cattle and Dairy
- Largest impacts:
  - Cattle-related Activities
  - Milk-related Activites
- Surprising to see other livestock production ↓

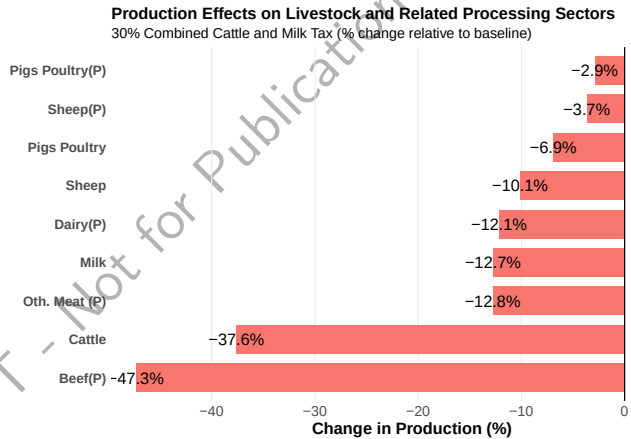


Figure 5: Impact of cattle and dairy shocks on livestock-related production. (P) denotes Food Processing Activity.

Household Income

- NFS Farm System Classifications
- Other ≡ Mixed Farms, Pigs, Poultry
- Cattle ≡ Cattle Rearing
- Cattle Other ≡ Cattle Finishing
- RFOther Households:
  - Pigs & Poultry Capital Intensive (76% of Factor Payments)
  - Factor Demand for Capital declines

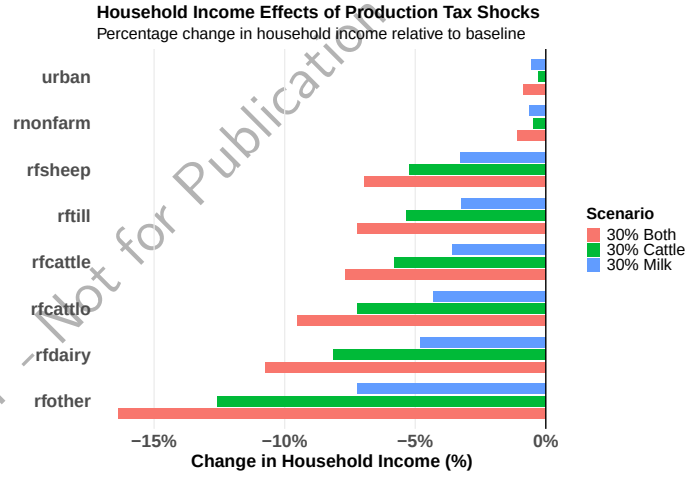
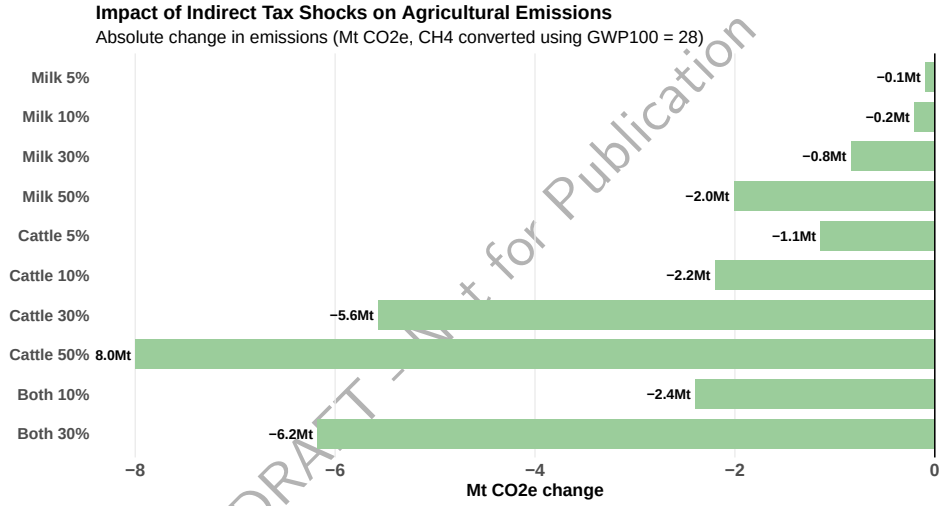


Figure 6: Impact of cattle and dairy shocks on Household Income. RF denotes Rural Farming.

CH_4 Agricultural Emissions - Impact of Shocks

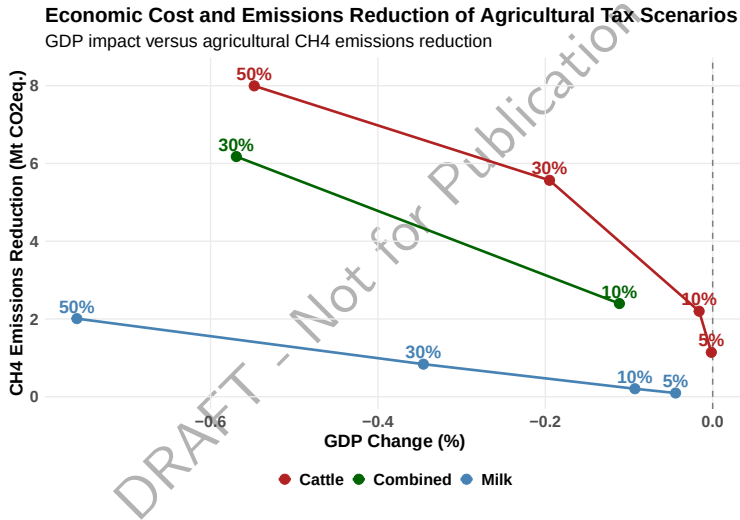
- **Preliminary results:** Initial decomposition of CH_4 emissions impacts under tax shocks
- Converted CH_4 emissions to $MtCO_2eq.$ using $GWP_{100} = 28$
- CH_4 emissions by GTAP Agricultural Sector: (Endowment-based)
  - CTL - Bovine cattle, sheep and goats, horses
  - OAP - Animal Products
  - RMK - Raw Milk
- Computed changes in baseline emissions based on change to output under tax shocks
- Further work will refine abatement representation and emissions–output linkages

CH_4 Agricultural Emissions Reduction



Preliminary impact of tax shocks on CH_4 emissions ($MtCO_2eq.$) from Agriculture, assuming all other emissions held constant.

CH_4 Emission Reduction Cost Effectiveness



GDP % Change per $MtCO_2eq$. CH_4 emissions reduced, from agriculture activities.

Limitations in Current State

- **Labour Types:** Currently only contains Paid and Unpaid Labour
- **GHG Emissions Data:** Emissions data still to be incorporated fully into the model
- **Elasticities:** Elasticities to be revised, with Ireland-specific elasticities included where possible

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Thank you