# Counterfactual Analysis

Our study attempts to estimate the magnitude of effect on CO2 emission using Fermi Estimation, with data from multiple sources. The results and data used are presented in *"Weighted_CO2_Emissions_by_Province.xlsx"*

Our model estimated $\hat{\beta} = 2.0983$. The estimated price elasticity of supply for canola is approximately 2.10. A 1% increase in canola price is expected to cause a 2.1% increase in canola production in the long run. In a time series, this implies:

$$q_{t+1} = q_t * (1 + 2.1\%)$$

In other words, the quantity produced in the next time period is expected to be 2.1% higher than the current period's observation. According to our collected data, the quantity of canola disposition as of 2024-07 is 21325.3 metric tonnes. Thus, the disposition of 2024-12 is predicted to be $21325.3 * 102.1\% = 21733.1$ metric tonnes, (approx. $24000.7$ tons).

According to The Canola Council of Canada, the provincial share of canola production is as follows: Saskatchewan 53%; Alberta 29%; Manitoba 17%. (Baron, 2021)

According to a report by the European Commission (EC), the greenhouse gas emissions from cultivation of canola in Canada, by province, are as follows: (EC, 2016)
(in unit of kilogram CO2-equivalents per dry ton )

| A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|
| Table 20: Emission of GHG from cultivation of canola | | | | | | | | |
| | Single emissions(kg CO2eq/dry-ton) | | | | | | Total emissions | |
| Province | Region | Seeding | Fertilizer Procution | N2O field emissions | Pesticide production | Field operation | **(kgCO2eq /dry-ton)** | eq/MJKg CO2 FAME |
| MB | RU 23 | 2.4 | 262.5 | 523.5 | 4.2 | 73.1 | **865.7** | 33 |
| MB | RU 24 | 2.2 | 266.5 | 510.6 | 3.7 | 64.9 | **847.9** | 33 |
| SK | RU 28 | 2.5 | 212.8 | 499.5 | 3.8 | 71.4 | **790** | 30 |
| SK | RU 29 | 2.5 | 203.1 | 319.4 | 3.6 | 63.4 | **592** | 23 |
| SK | RU 30 | 2.2 | 190.2 | 206.5 | 2.8 | 55.1 | **456.8** | 18 |
| AB | RU 34 | 2.2 | 170.4 | 421.2 | 3.3 | 57.7 | **654.8** | 25 |
| AB | RU 35 | 1.9 | 154.2 | 338.4 | 2.6 | 54.9 | **552** | 21 |
| AB | RU 37 | 2.1 | 166.6 | 198.2 | 2.8 | 58.3 | **428** | 16 |

*Weighted_CO2_Emissions_by_Province.xlsx - Sheet2*

Using the data from these two sources, with the predicted domestic production of canola, we are able to calculate:

- Historical share of canola production, for each of the three provinces.
- Estimated canola production, by province
- Estimated CO2 emission from canola production, by province

| | Predicted Domestic Total Production of Canola (tons) | Historical Share of Canola Production by Province | Estimated Production of canola (tons) | Historical CO2 Emissions from Canola Planting (kg CO2eq/dry-ton) | Estimated CO2 Emission (kg CO2eq) | **Total Estimated (kg CO2eq)** |
|---|---|---|---|---|---|---|
| Alberta | | 0.53 | 12720.371 | 544.9333333 | 6931754.17 | |
| Manitoba | 24000.7 | 0.29 | 6960.203 | 856.8 | 5963501.93 | **15396097.04** |
| Saskatchewan | | 0.17 | 4080.119 | 612.9333333 | 2500840.939 | |
| *Source:* | *Model prediction* | *CanolaCouncil* | *(Calculated)* | *ECEU* | *(Calculated)* | *(Calculated)* |

*Weighted_CO2_Emissions_by_Province.xlsx - Sheet1*

The total CO2 estimated is 15396097 kilogram CO2-equivalents, for each 1% increase in the price of canola seeds in Canada.

## References

Baron, V. (2021, October 20). The environmental footprint of canola and canola-based products (part 1). Canola Council of Canada. https://www.canolacouncil.org/research-hub/environmental-footprint-of-canola/

Regional greenhouse gas emissions from cultivation of canola ... (2016). https://energy.ec.europa.eu/system/files/2017-12/report_on_ghg_emissions_of_cultivation_of_canola_oilseed_in_canada_0.pdf