

Disaggregated greenhouse gas emissions from a Tropical Andes megacity region

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1. Introduction / motivation

- Several international organizations, e.g. UNDP and UNEP, have recently recognized the importance of **empowering sub-national decision levels on climatic governance** according to the **subsidiarity principle**. Regional and municipal authorities are directly responsible for land use management and for regulating economic sectors that emit greenhouse gases (GHG) and are vulnerable to climate change.
- This investigation was developed within the frame of the **Regional Integrated Program on Climate Change for the Cundinamarca-Bogota Region (PRICC)**, an initiative aimed at incorporating the climate dimension into the regional and local decision making. The region composed by **Bogota and its nearest, semi-rural area of influence (Province of Cundinamarca)** is the most important population and economic center of Colombia. Our investigation serves two purposes: a) to **establish methodologies for estimating regional GHG emissions appropriate to the Colombian context**, b) to **disaggregate GHG emissions by economic sector** as a mitigation decision making tool.

2. Methodology

Reference methodology:

Intergovernmental Panel on Climate Change - IPCC - Guidelines for National Greenhouse Gas Inventories, 1996

Inventoried GEI: CO₂, N₂O, CH₄, HFCs, PFCs

Key concept:

$$E = Ac \cdot Fe$$

E = Emission
Ac = Activity data
Fe = Emission factor

Bottom-Up (BU) Regionally disaggregated activity data for emission sources

Example:

CO₂eq Emissions (Gg) from fossil fuel use in transportation

$$E_{CO_2} = Ac_{REG\ transp} \cdot Fe$$

Ac_{REG transp} = Fuel use in the regional transport sector (TJ)

Fe = Emission factor (Gg CO₂ / TJ)

Top-Down (TD) Nationally aggregated activity data for emission sources

Example:

CO₂eq Emissions (Gg) from burning fuel in the regional textile industry

$$E_{CO_2} = Ac_{REG\ tex} \cdot Fe \quad Ac_{REG\ tex} = IE_{NAL\ tex} \cdot VA_{REG\ tex}$$

$$IE_{NAL\ tex} = \frac{Ac_{NAL\ tex}}{VA_{NAL\ tex}}$$

Ac_{REG tex} = Fuel use in the regional textile industry (TJ) calculated from the national energy intensity indicator, **IE_{NAL tex}** (TJ/\$)

Ac_{NAL tex} = Fuel use in the national textile industry (TJ)

VA_{NAL tex} y VA_{REG tex} = Added value (\$) in the textile industry (national and regional, respectively)

Use of indicators:
Energy intensity, GDP, fertilizer use intensity

4. Conclusions and perspectives

- Data / estimations are internally consistent / reasonable → **information sources used for BU calculations and devised TD methodologies could potentially be used for GHG emission estimations in other regions of Colombia.**
- Calculated **per capita emissions, 1.7 ton CO₂-eq/hab-year for Bogota and 4.4 ton CO₂-eq/hab-year for Cundinamarca** (excluding emissions due to land-use change), **do not reflect the fact that Cundinamarca provides goods and services to the city of Bogota.** A deeper analysis is thus required to quantitatively account for Bogota's urban metabolism, including GHG emissions associated with consumption patterns.
- The sectors that contribute to 60% of emissions in Bogotá and Cundinamarca are considered to be the main GHG mitigation assessment targets.

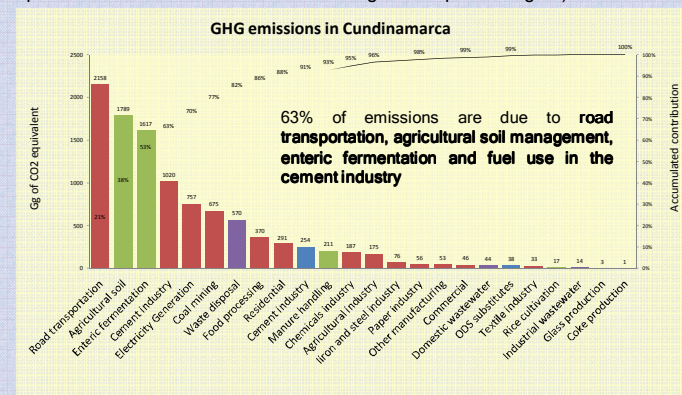
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3. Results

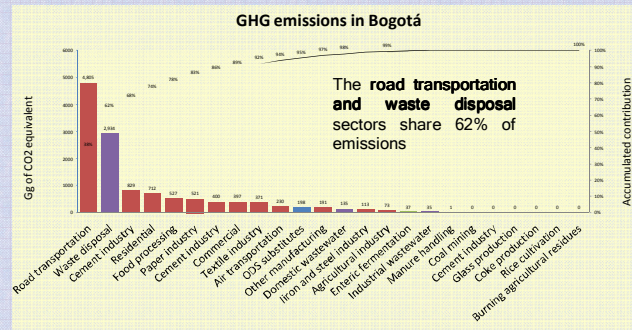
The total GHG emissions in the Cundinamarca-Bogota Region on 2008 are estimated at **22.96±1.25 (1-sigma) Tg of CO₂ equivalent** (10.46±0.93 Tg CO₂-eq from Cundinamarca and 12.51±0.83 Tg CO₂-eq from Bogota).



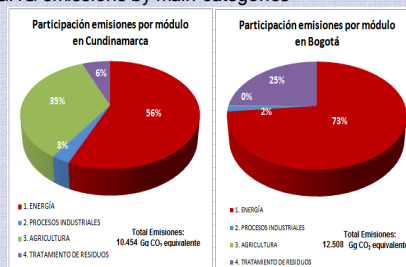
TD methodologies, based on national and regional energy use intensity, per capita consumption and fertilizer use, were developed and applied to estimate activities for following categories:

- Fuel use in industrial, commercial and residential sectors.
- Use of ozone depleting substances (ODS) and substitutes.
- Fertilizer use (for total emissions of agricultural soils).

The emissions from the remaining 22 categories were calculated using BU methodologies given the availability of regional information.



Participation GHG emissions by main categories



Conventions:

- Emissions from fossil fuel use and coal mining fugitive emissions
- Emissions from agricultural activities
- Emissions from solid waste disposal and from domestic and industrial wastewater
- Emissions as a byproduct of industrial processes and from using of ozone depleting substances substitutes