

Carbon-Embedded Pro-Poor Policies in Local Government: Evidence from Sleman Regency, Indonesia, Using a Regionalized EEIO Analysis

Topic: Input-Output Analysis: Regional policies (2)

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Research Question

Sleman regency, a region located in Indonesia, is still facing poverty problems despite having stable economic growth. In 2024 the percentage of poor people in 2024 was 7.46%, slightly decrease from 7.52% in 2023. Nevertheless, in absolute terms, the number of poor increased from 97,500 people in 2023 to 97,940 in 2024.

At the same time, greenhouse gas (GHG) emissions have positive trend with carbon dioxide (CO₂), increasing from 1,181.9 Gg in 2011 to 2,426 Gg in 2024 whereas methane (CH₄) and nitrous oxide (N₂O) remained stable. Moreover, GHG emissions have been dominated by energy sector that rose from 1,126.5 Gg-CO₂eq in 2011 to 2,135.9 Gg-CO₂eq in 2024.

Compounding these challenges, local governments in developing countries often lack survey-based input-output tables due to high costs. To address these limitations, this study examines whether a regionalized EEIO model can generate reliable linkage and emission multipliers to guide Carbon-Embedded Pro-Poor Policies design at the local government level. By internalizing regionalized IO table into EEIO analysis, this study provides a practical analysis of aligning inclusive growth with sustainability at regional level.

Methodology

2DLQ (Bidimensional Location Quotient) is a technique of estimating regional domestic coefficients through a new formulation based on a parameter alpha to correct the productive specialization and parameter beta to correct the size of purchasing industry (Pereira-Lopez et al., Spatial Economic Analysis, 2020). By rescaling national input-output (IO) technical coefficients, the method approximates regional production structures and interindustry transactions in the absence of survey-based IO tables. Incorporating both supply- and demand-side characteristics, 2DLQ provides a theoretically consistent and cost-efficient procedure for regionalizing national IO matrices.

The resulting regional IO table is then embedded within an environmentally extended input-output (EEIO) framework to quantify carbon emissions embodied in intersectoral flows. These emission coefficients can be used as an important consideration for formulating more environmentally sustainable economic policy, particularly when the local governments intend to intervene in specific sectors.

Data

The sectoral performance framework relies on a regionalized Input-Output (IO) table for Sleman from Yogyakarta Special Region (province level) IO table. The downscaling process utilizes recent GRDP (Gross Regional Domestic Product) data to capture recent sectoral performance.

Next, that EEIO analysis enables the identification of sectors with the highest carbon intensities and emission contributions (i.e., carbon footprint), providing insight into which economic activities may pose environmental risks despite their role in local economic growth or poverty alleviation. In this study, the greenhouse gas (GHG) coefficients by sector were prepared separately from the regional IO table from Statistics Indonesia (BPS), Greenhouse Gas Emission Intensity by Industry and Household, using the latest available data (2023). The values were converted from tones CO₂e per billion IDR to kg CO₂e per million IDR to ensure consistency with GRDP units and then matched to the IO sectors for the EEIO analysis.

Finally, assessing carbon-embedded pro-poor policies will be conducted by categorizing local government expenditure in extreme poverty into IO sectors. The assessment employs 2024-2025

budget realization data released by The Regional Financial and Asset Management (BKAD) of Sleman Regency.

Novelty of Research

Rum et al., Environmental Science and Policy (2024) conducted the Environmentally Extended Multi-Regional Input-Output (EEMRIO) model to assess the carbon footprint and carbon intensity at provincial level in Indonesia. Furthermore, the study provides a comprehensive overview of each province's contribution to national emissions, as well as the interregional trade links and their environmental impacts. However, their approach is macro-level and does not capture emission dynamics at the sub-provincial level, such as regencies or cities. This research fills that gap by narrowing the focus to the Sleman Regency level and using the EEIO model to generate more detailed spatial and sectoral analysis. This approach allows for the identification of dominant emission-contributing sectors at the local level that are not detected in national or provincial-scale studies.

This study implements 2DLQ-based IO regionalization approach within an EEIO framework to bridge the gap between growth-oriented development and carbon footprint mitigation at regional level. As an alternative to survey-based IO tables, especially for regional government in developing countries that have budget limitation, this study explains that a regionalized EEIO framework can provide intersectoral linkages alongside extended carbon footprints.