

Paper Summary

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Title: The assessment of urban eco-efficiency of Brazilian municipalities based on directional distance fun

Authors: Andreia Zanella, Renata Oliveira

DOI: 10.1108/JM2-11-2024-0369

Year: 2025

Publication Type: Journal

Discipline/Domain: Urban Sustainability / Environmental Management

Subdomain/Topic: Eco-efficiency assessment, Data Envelopment Analysis (DEA), Sustainable Developm

Eligibility: Eligible

Overall Relevance Score: 90

Operationalization Score: 95

Contains Definition of Actionability: Yes (implicit and explicit in “actionable insights” framing)

Contains Systematic Features/Dimensions: Yes

Contains Explainability: Yes

Contains Interpretability: Yes

Contains Framework/Model: Yes (Expanded Urban Eco-efficiency DEA-DDF model)

Operationalization Present: Yes

Primary Methodology: Quantitative (DEA with Directional Distance Function)

Study Context: Urban eco-efficiency in large Brazilian municipalities (>300k inhabitants)

Geographic/Institutional Context: Brazil, Sustainable Cities Program (ICS-SDSN)

Target Users/Stakeholders: Municipal policymakers, urban planners, environmental agencies

Primary Contribution Type: Empirical assessment model and benchmarking tool for urban eco-efficiency

CL: Yes – clarity in KPI definitions linked to actionability

CR: Yes – contextual relevance tied to Brazilian urban and regional disparities

FE: Yes – feasibility considered through realistic improvement scenarios and GDP constraint

TI: Partial – scenarios consider current data but not explicit urgency thresholds

EX: Yes – model explainability via indicator weights and peer benchmarking

GA: Yes – alignment with SDGs and municipal sustainability goals

Reason if Not Eligible: N/A

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****Discipline/Domain:****

Urban Sustainability / Environmental Management

****Subdomain/Topic:****

Eco-efficiency assessment, DEA, Sustainable Development Goals

****Contextual Background:****

Evaluates eco-efficiency of Brazilian cities using SDG-linked KPIs, combining desirable and undesirable outputs

****Geographic/Institutional Context:****

Brazil; Instituto Cidades Sustentáveis (ICS) and Sustainable Development Solutions Network (SDSN) data

****Target Users/Stakeholders:****

Municipal decision-makers, environmental managers, policy analysts.

****Primary Methodology:****

Quantitative (DEA with Directional Distance Functions).

****Primary Contribution Type:****

Methodological innovation in urban eco-efficiency measurement and operational policy guidance tool.

General Summary of the Paper

This study develops and applies an optimization model based on Data Envelopment Analysis (DEA) and

Eligibility

Eligible for inclusion: ****Yes****

How Actionability is Understood

Actionability is framed as the ability to provide “actionable insights” to policymakers through eco-efficiency

> “The model specified can identify best practices and areas for targeted improvement, offering actionable

> “...highlights their specific strengths and weaknesses, providing decision-makers with alternative scena

What Makes Something Actionable

- Clear linkage to specific, measurable KPIs.
- Ability to benchmark against high-performing peers.
- Scenario-specific improvement pathways.
- Alignment with SDG targets.
- Interpretability via weight assignment to indicators.
- Feasibility maintained by keeping GDP (wealth proxy) constant.

How Actionability is Achieved / Operationalized

- **Framework/Approach Name(s):** Expanded Urban Eco-efficiency Framework (DEA-DDF with SDG-linkage)
- **Methods/Levers:** DEA with directional distance functions; weight restrictions to ensure KPI relevance
- **Operational Steps / Workflow:**
 1. Select 8 KPIs (inputs, desirable outputs, undesirable outputs) aligned with SDGs.
 2. Collect municipal data (2019–2022) from ICS-SDSN.
 3. Apply DEA-DDF model under weight constraints.
 4. Run three improvement scenarios with fixed GDP per capita.
 5. Identify peer cities for benchmarking.
 6. Analyze indicator weights to detect strengths/weaknesses.
- **Data & Measures:** GDP per capita, % water/sewage/waste collection, % conservation area, waste g
- **Implementation Context:** Brazilian municipalities with >300,000 inhabitants.

> “...enables the reflection of alternative decision scenarios...providing actionable insights to support the

Dimensions and Attributes of Actionability (Authors' Perspective)

- **CL (Clarity):** Yes – KPIs precisely defined and linked to SDGs.
 - > “...enables local governments to prioritize their efforts effectively...” (p. 8)
- **CR (Contextual Relevance):** Yes – tailored to Brazilian regional disparities.
- **FE (Feasibility):** Yes – keeps GDP constant to reflect realistic constraints.
- **TI (Timeliness):** Partial – scenarios reflect current data but no explicit urgency metric.
- **EX (Explainability):** Yes – indicator weights and peer benchmarking enhance interpretability.

- **GA (Goal Alignment):** Yes – fully aligned with SDG targets.
- **Other Dimensions Named by Authors:** Equity in service provision; environmental burden mitigation.

Theoretical or Conceptual Foundations

- WBCSD eco-efficiency principles.
- Expanded eco-efficiency definition from Oliveira et al. (2017).
- DEA literature on environmental performance with undesirable outputs (Chung et al., 1997; Seiford & Z

Indicators or Metrics for Actionability

- 8 SDG-linked KPIs (input, desirable outputs, undesirable outputs).
- Eco-efficiency scores from DEA-DDF model.
- Peer similarity coefficients (λ values).
- Scenario-specific performance differentials.

Barriers and Enablers to Actionability

- **Barriers:**
 - Data variability and quality.
 - Regional inequalities in infrastructure and governance.
 - Environmental pressures in Amazonian cities.
- **Enablers:**
 - SDG-aligned indicator framework.
 - Benchmarking culture.
 - Scenario-specific targeting of improvements.

Relation to Existing Literature

Builds on DEA-based eco-efficiency studies but is the first to apply multiple directional vectors to urban e

Summary

This paper operationalizes actionability in urban sustainability assessment through a DEA-DDF model tha

Scores

- **Overall Relevance Score:** 90 — Strong conceptual clarity on actionability (via actionable insights fra

- **Operationalization Score:** 95 — Fully specified DEA-DDF operational workflow with real-world data,

Supporting Quotes from the Paper

- “The model specified can identify best practices and areas for targeted improvement, offering actionable
- “...highlighting specific strengths and weaknesses, providing decision-makers with alternative scenarios
- “...enables the reflection of alternative decision scenarios...providing actionable insights to support the

Actionability References to Other Papers

- Oliveira et al. (2017, 2019, 2020) – Expanded eco-efficiency assessment methods.
- Chung et al. (1997) – Incorporating undesirable outputs in DEA.
- Seiford & Zhu (2002) – Desirable input modeling.
- WBCSD (2000) – Eco-efficiency definition.